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Boiler-house Auxiliaries

PRACTICE with regard to the driving of auxiliary plant in generating stations seemed until recently to have become stabilised. For many years the induction motor normally supplied from unit transformers or from separate high-voltage alternators has held the field. Its advantages in low first cost, reliability, small maintenance charges and relatively little electrical losses through transformation have caused it to destroy the former vogue of the d.c. motor, in spite of the way in which the latter lent itself to close speed regulation.

Nevertheless, speed control still remains one of the most important requirements in boiler-house operation, especially for mechanical stokers, induced-draught fans and, in some cases, feed pumps.

In order to adapt the constant-speed induction motor to such work, mechanical and fluid gearing has been employed successfully enough to prevent serious consideration being given to a reversion to d.c. in stations of the usual type. The decision to use d.c. auxiliaries in the reconditioned Brimsdown A generating station has, however, raised the old discussion of a.c. versus d.c. in a new form, as, although this station is being equipped with high-pressure forced-circulation boilers, the general principle remains the same.

Combustion has made a great advance towards becoming an exact science, and it may be asked whether steam-raising does not lend itself to the same kind of centralised control as that applied to the electrical system by an extension of the methods that have proved effective at Hackney.

It is in this direction that d.c. has the most favourable opening, as variable voltage operation seems to furnish the most promising means of achieving this end. The analogy with electrical transmission is not exact, as the main function of centralised boiler control is to secure sustained efficiency by meeting changes in combustion conditions when fluctuations in the load alter the demand for steam. Local regulation would still be necessary to care for details, such as the suitability of given grate speeds for different fuels (an important point under the new coal-selling schemes) and the amount of flue dust in induced-draught fan passages. Here the fine speed-control possible with d.c. would be distinctly advantageous, but not enough so to justify the adoption of d.c., as a.c. commutator machines would also be suitable.

With centralised control some modifications in operating practice might follow. For example, the customary method of regulating on one of a number of boilers, the others being run at as nearly constant a load as possible, might be improved upon, as the efficiency output curve is nearly flat over a considerable range.

The question arises as to whether the securing of the lowest electrical losses by the use of a.c. may not be made at the expense of far higher heat losses, and even with higher cost of equipment. In the case for unified boiler control which Messrs. F. W. Young and F. A. Eastwood presented before the Institute of Fuel earlier in the year, it is claimed that often the capital expenditure on Ward-Leonard equipment was more than offset by reduction in the number of switches required.

With regard to reliability, the authors said that if a station cut adrift from the grid, the auxiliaries would be unaffected by falling frequency, as the d.c. voltage could be raised to keep them running at the same speed.

Many points for investigation remain, such as secondary air requirements, the most suitable characteristics for all boiler-house auxiliaries, and, finally, how far speed governing meets all needs for securing the best conditons for the economical burning of fuel.

Boiler-house operation is still far from becoming stereotyped; the great variations found in different classes of coal are alone enough to prevent this, and discussions of the kind to which the paper mentioned give rise are likely to prevent our too readily accepting things as they are as the best that can be done.

Gas-filled 132-kV Cable

Mention is made in the report of the Central Electricity Board for 1936 of arrangements for installing nitrogen-filled cable to operate at 132-kV. This cable is a production of W. T. Glover & Co., which was described in these columns during its early stages of development. Since then, Mr. C. J. Beaver informs us, extensive work has been done in all the various aspects of manufacture and operation, the latter including the behaviour of the cable under conditions causing trouble and methods of locating the damaged part, as well as in the design of joints and sealing ends. We describe its leading features in this issue. The gas-filled cable differs in many ways from the gas-impregnated cable (a development of Callender's Cable and Construction Co.), which was described by Mr. A. N. Arman in his I.E.E. paper last month, one of the most important points of difference being the use of pre-impregnated paper as against dry paper, but common to both is the use of gas at 200 lb. per sq. in. In both cases the basis of design is that ionisation shall not occur under any circumstances to be anticipated in operation.

Insulating Helmets

How much danger does a linesman run of bringing his head into contact with a high-voltage conductor? An experienced man will, no doubt, have a subconscious idea of the distance between any part of his body and a live structure, but circumstances may cause a momentary relaxation of attention, with serious consequences. Monsieur M. Dagory, in a paper presented to the Société Française des Electriciens, showed that out of eleven deaths in ten years due to shock on a 15-kV system three were received on the top of the head, one on the chin, three through the hands and one through the feet, the cause of the others being uncertain. The French State Railways have devised an insulating helmet, consisting of several layers of oiled silk, for use by workers exposed to possible direct contact with live conductors. The breakdown strength of even 0.03 mm. of this material is about 5 kV, and the weight of the helmet, though increased by an outer layer of tough rubber, is inconsiderable and the linesmen are reported to wear it without inconvenience.

Awakening China

China is one of the world's most difficult markets, but the latent possibilities are tremendous. It is also one of the most difficult countries to govern, and yet it has a Central Government which is active in many directions—economical as well as political. One of its moves has been the appointment of a National Construction Committee, whose activities include an effort to co-ordinate and encourage electrical development. So far but little progress has been made. There has been some concentration of plant; a testing and approvals laboratory has been established; and a beginning has been made with the standardisation of systems and charges. No doubt with the right kind of guidance the pace would be quickened, and that is where British electrical manufacturers could lend a hand. The formation of the F.B.I. China Committee and the appointment of Mr. Kirkpatrick as resident representative of the Export Credits Guarantee Department are signs of a reviving interest in trade with China, and it is to be hoped that these departures will lead to the establishment of firmer trade relations with remunerative results.

An Eloquence Controller

An original method of setting a time limit to speeches was demonstrated at the E.P.E.A. Kent Section dinner. The controlling device was made in the form of a man's face, and the eyes lit up at the beginning of a speech. The inexorable passing of the minutes was shown by the steady movement of a needle across the mouth. After eight minutes one eye winked, but the facetious expression had to be regarded seriously, as it denoted that in exactly two more minutes all the lights in the room would be switched off. Drastic, no doubt, but effective, since no speaker had the temerity to put this to practical proof. The principal component of "Mr. Tork" (as the inventors, the staff of the Ashford undertaking, call him) is a demand-indicator mechanism. The idea is worth being copied at other functions.

"Conditioned" Air

How much truth is there in the statement, often made, that conditioned air, although it so materially improves the indoor atmosphere, yet lacks certain properties that gives "life" to the air outside? The American Society of Heating Engineers is endeavouring to discover the so-called "intangible qualities" that may cause the difference. Ozonising, ionisation, filtering by electrostatic precipitation and treatment with germicidal ultra-violet rays are all under consideration. Investigations on these lines are of significance to this country also because, although the climate of Great Britain has not compelled us hitherto to take the same interest in air-conditioning as has been necessary in some other countries, the hygienic advantages of purified air of the correct humidity are rapidly becoming more widely acknowledged here. Soon we may hope to see all first-class public rooms, at least, suitably equipped.

The Watford Ljungströms

In the Report of the Central Electricity Board for 1936 it was stated that improvements in economy of production at Watford and Grimsby generating stations had justified their selection for operation, although neither had been scheduled under the original grid scheme. This is reflected in the 15,000-kW extension of the Watford station, which is being officially put into use to-day, and in the installation of new switchgear of higher rupturing capacity. The promotion of Watford is not surprising, as a thermal efficiency of over 19 per cent. in 1935 placed it among the best of its class—those generating between 60 and 100 million kWh per annum. This is a good showing for a station the biggest set in which had a capacity of only 7,000 kW, and no doubt Mr. A. W. Barham, the chief engineer and general manager, looks to his sixth and larger Ljungström to enable him to pass the 20 per cent. mark.

Kitchen Planning

There are many useful electrical appliances which should form a part of the modern kitchen equipment, but modern kitchens are not always commodious enough to take them. Nevertheless, with proper arrangement space can be found for a great deal of equipment, even in the smallest of kitchens. To render assistance to housewives in this matter the Portland General Electric Co. (U.S.A.) has established a kitchen-planning service which any customer can call upon for advice. This department suggests suitable lay-outs and even colour schemes, and, if necessary, proposes structural alterations, which are confirmed by the company's engineering department. The company has found its new service to be a "paying proposition." As a result of the preparation of 139 plans during three months of last year it disposed of 231 major appliances—118 ranges, 80 water heaters, 25 refrigerators and eight dish-washers. These, it is stated, represent an additional annual revenue of $8,600.

Electric Propulsion

Although it has its humorous side, an incident related by *Electric Light and Power* (Chicago) is an example of the difficulties encountered by electric power companies during the recent serious floods in America. Operators at Louisville, Kentucky, were in a position to energise an important feeder, but because the area was under water they decided to investigate before closing the switches. It was fortunate that they did. The water was within three feet of the cross-arms of the poles and people were propelling boats by pulling hand over hand along the conductors.

Large-scale Fertiliser Production

BY dissolving finely ground phosphate rock in sulphuric acid the insoluble phosphates are rendered soluble in water, a form in which they are more quickly available to plant life. This is the basic principle of the manufacture of superphosphate, as we observed it during a recent visit to the new superphosphate factory at Avonmouth, of National Fertilisers, Ltd.

The works are adjacent to Avonmouth Docks and the partially ground rock, largely from North Africa, is conveyed from the

ships to the factory unloading station by an aerial ropeway equipped with mechanical trip switches by which the spacings of the trucks at the station are controlled automatically. From a receiving bin a belt feeder conveyor serves the rock on to an inclined conveyor which, at its far end, feeds a horizontal conveyor running from end to end of the 300-ft. by 110-ft. phosphate store building. By means of a travelling feeder incorporating the conveyor belt in a jockey-pulley arrangement the phosphate can be distributed in large heaps throughout the length of the store. The 9-ft.-centre conveyor feeder, the 190-ft.-centre inclined conveyor and the store conveyor are driven by 3-h.p., 15-h.p. and 15-h.p. motors, respectively, all *via* chain transmission and "Radicon" worm reducing gears.

A drag-line scraper reclaims the phosphate for grinding by dragging it along the floor to a grid at the floor level through which it falls to a hopper. A double-drum reversing winch serves this scraper reclaiming equipment and is driven by a 50-h.p., 730-r.p.m. motor *via* a Renold chain. The winch is controlled by hand-operated levers and ropes from a cabin which commands a clear view of the storage space. The pull-back rope runs over a travelling pulley-block housed, with its controlling ropes, within two channels forming a box section around three sides of the building 3 ft. above the floor. Thus by altering the position of the travelling block by means of winches in the control cabin the path of the scraper bucket can be varied to suit the position of the heap of phosphate.

Transit of the phosphate from the underground hopper to the grinding plant is *via* a belt conveyor feeder under the hopper (3 h.p.) and a 10-h.p. motor-driven 215-ft.-centre inclined belt conveyor within an enclosed gantry. An Igranic 18-in. magnetic head pulley extracts tramp iron before the phosphate is passed to the grinding equipment.

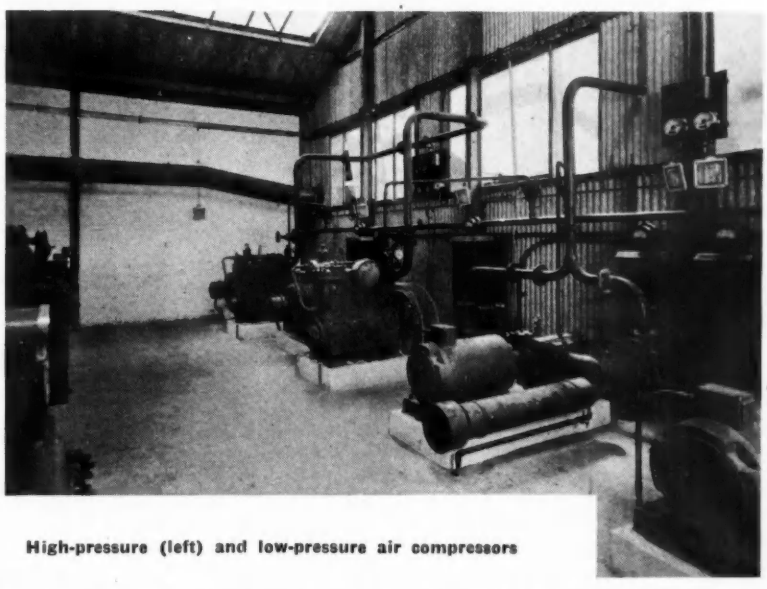
Within the grinding house the phosphate first passes over an inclined "grizzly" screen, the oversize from which is delivered to a Sturtevant vertical rotary crusher driven by a 25-h.p. motor with a "Texrope" reducing drive of 950 r.p.m. to 250 r.p.m. ratio. With the minus product from the grizzly screen the ground phosphate from the crusher passes to either of the two 20-ton storage bunkers by means of a worm conveyor. The rate of feed from each bin on to its feeder belt conveyor is controlled by an adjustable vertical operating gate. From the feeder conveyor a Redler conveyor takes charge of the material, conveying it to the top of the building and discharging it into a Sturtevant air separator. A 7.5-h.p. motor drives the Redler conveyor, a 960-r.p.m to 9-r.p.m. speed reduction being afforded by a belt and pulley, a Moss worm reducing gear and a single open-gear train combination. A 20-h.p. motor drives the separator *via* a simple fast and loose pulley scheme.

The phosphate fed into the separator passes into a fan centre tube and on to a spreading plate which revolves at about 250 r.p.m., giving a centrifugal action to the material whereby it is "thrown" into the air in the inner casing. A fan above draws the finer material upwards and this is deposited by centrifugal force into the outer casing from which it is conveyed *via* a 6-in. Redler and a horizontal worm conveyor to storage bunkers.

The oversize material from the separator is passed to a ring-roll mill, the product from which joins the feed from the 20-ton bunkers on its passage by a 9-in. Redler conveyor to the top of the building for another cycle. The ring-roll mill is driven by a 50-h.p. motor and incorporated gearing gives a speed ratio of 960 r.p.m. to 285 r.p.m.

A dust filter with a fan speed of 1,230 r.p.m. connects all potential dust points on the grinding plant, and dust from the filter is conveyed to the horizontal Redler on top of the storage bunkers by a 3-in. Redler. A countershaft serving the two 6-inch Redlers (separators), the 3-inch Redler (filter), the horizontal Redler and the dust filter system is driven by a 14-h.p. motor, the motor and countershaft speed ratio being 1,000 r.p.m. to 213 r.p.m.

The material is passed *via* weighing hoppers, a special feed regulator and a Fuller-Kinyon pump, on to the autoclave plant. The feed regulator, with its hollow pocketed rotating



High-pressure (left) and low-pressure air compressors

drum, is driven by a 2-h.p. motor, while a 40-h.p. motor serves the Fuller-Kinyon pump. At the large diameter discharge end of this worm-conveyor type pump compressed air is admitted. This "fluffs up" the material and thus assists it in its forward flow to the three rock charge hoppers serving the three autoclaves, respectively.

At points near the Fuller-Kinyon pump and rock discharge hoppers are diagrammatic representations of the system to the charge hoppers. These diagrams are equipped with red and green lamps to indicate when valves are shut or open. When the valves are operated the man in the autoclave building can control the path of flow of the material to the charge hoppers and signal to the operator at the pump. In the pump and charge hopper lines are incorporated electrically operated valves.

Redler feeders and separation plant [*Elec. Rev. photo.*

In each charge hopper is a rotary agitator driven *via* a Croft worm reduction gear by a 15-h.p. motor (720 r.p.m. to 55 r.p.m.). Compressed air delivered to the hopper also assists discharge.

Acid from the adjacent breaking-down plant of the National Smelting Co., Ltd., is received in an elevated storage tank from which it flows into any of the three acid eggs of the autoclave plants as required. Acid and phosphate are charged into the autoclave simultaneously, the rock first passing into the inner chamber of a special mixing valve, while the acid is discharged by compressed air into the outer chamber of the valve. At the same time a vacuum is maintained in the autoclave, causing the acid and rock mixture to be drawn in.

Each autoclave is a horizontal lead-lined and steam-jacketed rotating cylinder 21 ft. long by about 6 ft. in diameter internally. It is driven at one end by a 30-h.p. motor through a 960-r.p.m. to 36-r.p.m. Northern Manufacturing speed-reduction gear which drives on to pinion and spur gearing to give a final rotating speed of the autoclave itself of 4.12 r.p.m. The 60-ton loading of the autoclave is carried by two steel tyres which run on rollers. The charge is drawn into the autoclave through the hollow shaft at one end and the exhaust gases from the chemical reaction are evacuated through a similar shaft at the other end to gas cleaning plant.

Scrubbing water for this plant is obtained from the Avonmouth Docks by means of two 500-gal. per minute (125 ft. head) Worthington Simpson pumps directly coupled to 30-h.p. s.c. motors. A further "industrial" water supply within the works is served by a similar motor. The product from the autoclave is discharged by rotating the machine with the manhole-cover removed. From the timber hopper underneath the superphosphate passes on to a 52-ft. centre conveyor with a 2-h.p. motor and a "Radicon" reduction-gear drive (22 to 1 ratio). This conveyor discharges on to a double cable chain and bucket elevator leading to the superphosphate store, and the elevator has a 5-h.p., 710-r.p.m. to 73-r.p.m. drive and discharges on to a horizontal belt conveyor which delivers the superphosphate either directly to the store floor or to a horizontal conveyor traversing the store 25 ft. above the floor.

A four-motor grab crane spans the store and distributes the superphosphate as required. The crane hoisting, holding, traversing and travelling motors are of 36 h.p., 18 h.p., 3 h.p. and 15 h.p., and give final operating speeds of 80 ft. p.m., 80 ft. p.m., 150 ft. p.m. and 300 ft. p.m., respectively. The crane is also used to feed pulverising plant *via* "bumper" screens. Each pulveriser has independently driven beater and drum shafts, the beater drive being a 50-h.p. motor with "Texrope," with a reduction of 1,460 r.p.m. to 50 r.p.m., while the drum shaft is driven by a 4-h.p. back-geared motor with a speed reduction of from 960 r.p.m. to 50 r.p.m.

The product from the pulverisers, with the minus product from the "bumper" screens, is elevated to two International Combustion "Hummer" magnetic vibrating screens. The feed roll of each screen is driven by a 2-h.p. back-geared motor (945 r.p.m. to 99 r.p.m.), and the direct current for the magnetic vibrating units is supplied by a 2-kW, 110-V motor generator.

The product from the Hummer screens is either bagged for dispatch by road or conveyed to rail or ship for bulk dispatch. For creating a vacuum in the autoclaves there are three Reavell single-stage horizontal pumps. Each is driven by a 75-h.p., 720-r.p.m. motor.

For the high-pressure air supply to the acid eggs there are two two-stage vertical Reavell compressors driven by 50-h.p. motors. Igranic automatic electric-pressure control is employed for the compressors. The low-pressure air for feeding into the Fuller-Kinyon pump line and to the charge hoppers is supplied by 15-h.p., 720-r.p.m. directly motor-driven rotary compressors with similar control.

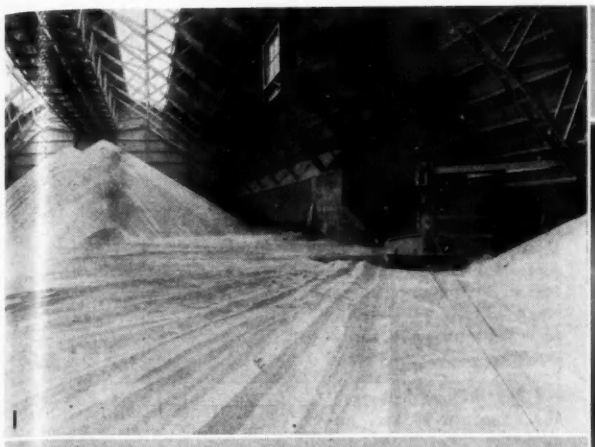
There is a total of well over 1,000 h.p. of motors installed throughout the works, ranging in size from ¼ h.p. to 75 h.p.; they were practically all supplied by Laurence, Scott & Electromotors, Ltd., and most of them are of the totally enclosed fan-cooled "Emcol" design. The hand-operated starters are of Allen West manufacture, while the push-button contactor equipments are Igranic, B.T.H., and M.E.M. products.

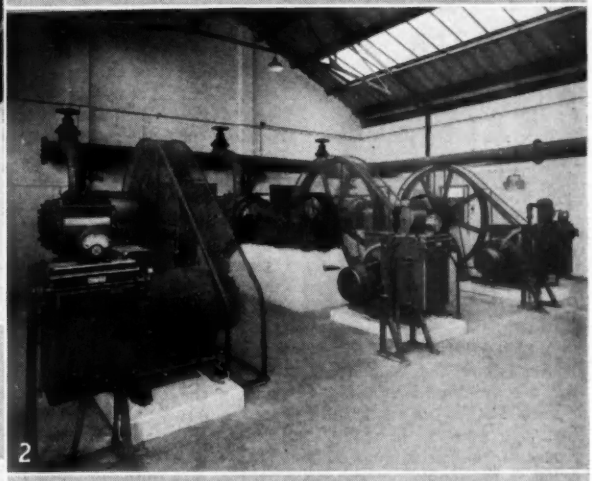
For lighting generally about the plant Dorman Smith prismatic totally enclosed reflectors with 60-W lamps are employed, while in the large phosphate and superphosphate stores 400-W and 250-W mercury-discharge fittings supplied by the Benjamin Electric, Ltd., have been installed.

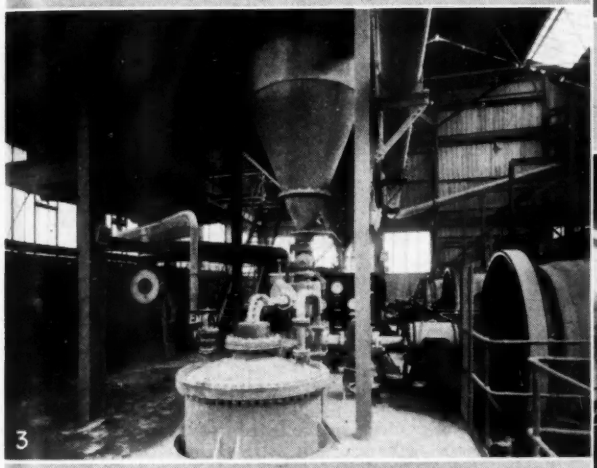
Electrical energy is received from the Bristol Corporation electricity undertaking at 6,600 V and is transformed to 440 V in a sub-station. B.T.H. truck-type cubicle switchgear governs the main in and out e.h.v. supply, while the 6.6-kV supply to the dockside pumping station is served by Allen West iron-clad equipment. A departure from the usual construction of l.p. distribution switchboard is the steel panel unit of B.T.H. manufacture. The 1,000-kVA Brush Electrical transformers have off-load tappings on the primary windings.

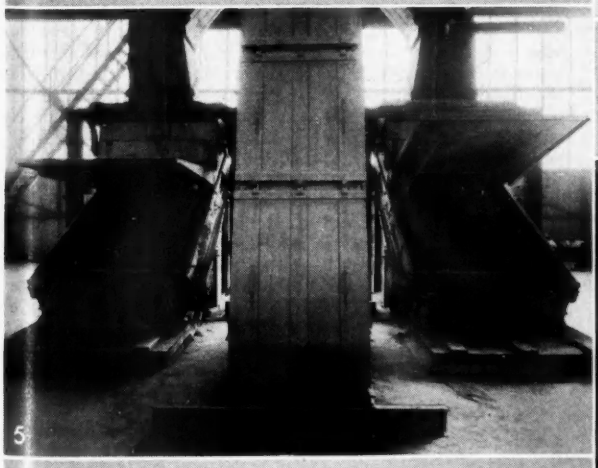
[*Elec. Rev. photo.*
Winding winch for drag-line scraper

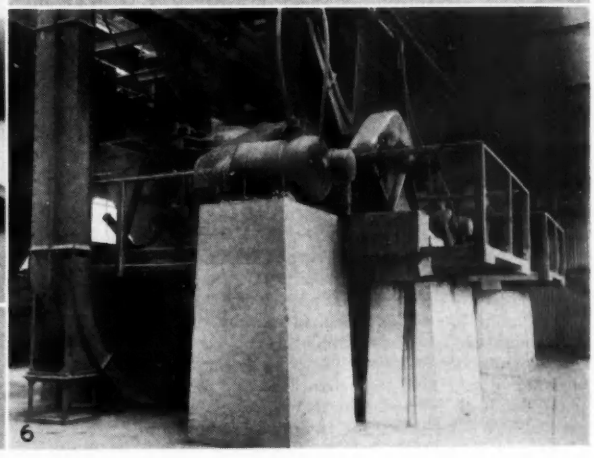
The whole of the electrical installation work was carried out by the electrical department of the National Smelting Co., Ltd. The planning and erection of the plant was carried out under the personal supervision of Mr. A. E. Higgs, M.I.E.E., chief engineer to the National Smelting Co., Ltd. We are indebted to National Fertilizers, Ltd., for permission to visit the works, and to Mr. C. W. J. Flook, assistant to Mr. Higgs, for his assistance in the collection of information.











In the Works of National Fertilizers, Ltd.

1. The rock store showing reclaiming bucket, winch house and control cabin. 2. Vacuum pumps serving autoclaves. 3. Autoclave plant: charging equipment on left. 4. Superphosphate store showing overhead crane and screening plant. 5. Magnetic superphosphate screens. 6. Drives for the ring-roll mills.

The Approach to Electrical Design

By G. H. Rawcliffe, B.A.(Oxon.)

Relationship between theory and practice

Mr. G. H. Rawcliffe is with the Metropolitan-Vickers Electrical Co., working on motor design

IT is a commonplace that there is a great gulf between academic design and the work of practising designers. This article seeks to estimate the cause of the discrepancy and the change in method and outlook on the part of the teacher of design which is necessary to bridge this gulf. Equally, it seeks to show the "practical" designer, who tends to regard academic ideas as pedantic, that he has misconceived the mission of the academic designer, and that he is rejecting a very powerful weapon of attack.

It is no essential criticism of the theoretical engineer that he has not at his finger-tips that large store of miscellaneous facts and "clinical" experience possessed by the man who has been practising for years as a designer. As it is impossible to teach "experience," the best that can be done is to produce pupils capable of imbibing experience subsequently as quickly as possible. The important point is that there shall exist between these two branches of engineering a unity of purpose and a mutual understanding—in fact, a common approach.

That this has not existed in the past is illustrated by extracts from the prefaces of many a book on design; for instance, Hopkins, in "Induction Motor Practice," refers to his experience in wondering, shortly after entering industry, "just what connection, if any, existed between these (academic) qualifications and the apparent business of a manufacturing designer." The academic engineer cannot be expected to produce the ready-made manufacturing designer, and if he has allowed his pupils and himself to believe that this is his aim they and he will be disappointed. Alternatively, if he believes that he is to be judged by the nearness with which he approaches this goal he is taking a very narrow view of his services.

There is ultimately no more difficulty in solving a hundred simultaneous equations than two, though the labour involved is appalling. The design engineer is constantly, in effect, solving simultaneous equations with huge numbers of unknowns; his work, in reality, is to resolve by approximation and generalisation as many of these unknowns as he can. These unknowns may be "scientific" in the strict sense of the word, economic or external; that is, concerned with the application of the machinery under design. The leading terms in the simplified "equations" are then fairly readily evaluated; the wonder is that after so much inspired guesswork the machinery does actually come so near to the behaviour expected of it.

The exact solution of even the most simple electromagnetic problems is, however, extremely toilsome and complex. The estimation of the performance of electrical machinery upon such rigorous lines is, therefore, quite out of court. On the other hand, books and papers written by design engineers tend to obscure the rigour of electromagnetism by a wealth of working rules and practical illustrations, and frequently call in ambiguity of language to promote confusion of thought.

Both Wrong

We tend, therefore, to develop two schools of thought, the excessively academic which sees engineering as signs and symbols only, and the "practical" which smiles at these visionary professors. In reality, of course, neither is right, and a good deal of harm may be done to the rising engineer by the feeling that it is necessary to take sides.

Academic design classes have tended towards the gaining of a rule-of-thumb technique to deal with some artificial system rather than a complete grasp of principle, which can be perfectly and more sharply illustrated by relatively simple examples. By an artificial system is meant, for instance, the case of the ideal induction motor with a sinusoidal field rotating in the air gap with all consideration of slot harmonics, eddy currents and so forth omitted. Chapman, for example, in his "Study of the Induction Motor," makes "the assumption that if the air gap field is resolved into sine-distributed components only the fundamental . . ." is of any importance. This assumption is only partly true, however, and in the absence of any note that such a system is an abstraction the pupil tends to believe that he is dealing with real induction motors. When, later, he is engaged on commercial design and finds that his technique no longer applies, he tends to lose faith in "college stuff" and begins to believe that academic persons are ignoramuses, and that the laws of science are "unpractical."

If, on the other hand, he had been told that his "college examples" were designed to inculcate the logic of machinery and did not necessarily represent more than a part of the conditions found in practice he might well derive from this instruction a mental stimulus to last for the rest of his days, whatever work he might undertake. If a man feels that he is no better for his training because he has "forgotten his fourth-year lectures" the approach to such instruction must have been wrong. Education, we have been told, is what is left when you have forgotten what you were taught.

All too rarely is the student of electrical engineering bidden to look to the rock whence his subject was hewn, and in the result there is many a young engineer who leaves college with considerable ability in so-called design and who yet could not define, and does not fully understand, the fundamental conceptions of inductance and reactance. That understanding which can give birth to a spontaneous and exact definition is worth far more to any design engineer than a large store of facts about the various complex circuits which have, on occasion, been used with polyphase machinery. Seldom is the distinction drawn between principles, which are eternal, and practice which may change.

Thought *versus* Empiricism

I have yet to see a design text-book which mentions the difference between things which are determinate and things which are determinable, and which emphasises the fact that electrical phenomena are essentially determinate though only sometimes determinable; yet this point is absolutely paramount, and the failure to recognise it has caused many an engineer to believe implicitly or explicitly that hard thinking is useless. He sees an apparently capricious or random element in electrical machinery, in the face of which logic would seem to be helpless, so he leaves it at that and relies on muddling through.

The academic designer must realise that his signs and symbols are at once less important and more important than he had supposed. Less important because they do not completely describe the apparatus as he had imagined; more important because they stimulate a mental habit of dealing with all relevant facts, technical or not, concerned with the design. The "practical man," on the other hand, must cease to believe that the best approach to any problem is through common sense (which is often uncommon nonsense) and experience (that name which men give to their mistakes).

Finally, it is, above all, necessary to develop a habit of mind which looks upon a scientific training in the broadest possible light and learns that the overriding entity is the scientific method. The scientific approach, once learnt, may be applied to problems which, in the narrow sense of that word, are not "scientific" at all, and, indeed, are far beyond the confines of electrical design. Without this habit of mind all statement is propaganda and all argument is special pleading. It is in the hope that some may give a moment's pause to such general matters of approach as this that this article has been written.

Tin Consumption

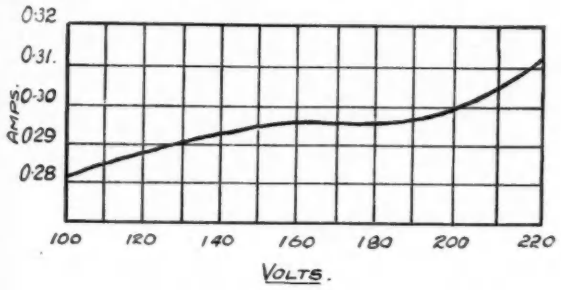
The March *Bulletin* of the International Tin Research and Development Council, published by the Hague Statistical Office, world consumption of tin in January increased by 18.4 per cent to 15,668 tons, against 13,237 tons in January, 1936. Activity in the principal tin consuming industries is at an appreciably higher level than a year ago, world tinplate production in January being at 311,000 tons, against 275,000 tons in the corresponding month of 1936, while the output of motor vehicles has increased from 473,000 to 501,000. World production of tin in January, at 13,660 tons, was at practically the same level as in January, 1936. World consumption statistics for the year ended January, 1937, show a total apparent consumption of 159,850 tons, an increase of 9.0 per cent. In the twelve months the consumption of tin in the United States increased by 19.5 per cent., as compared with the previous year, but in the United Kingdom the increase was only 1.8 per cent.

Testing Electricity Meters. By J. Bailey

Apparatus for precision voltage control

THE new Electricity Meters Act has considerably enhanced the importance of meter testing and recalibration. In the past careful and efficient testing of energy meters has not been regarded as of fundamental importance by many electricity supply authorities, but the new legislation will rapidly place meter testing upon a very different basis.

The requirements of the new Act will, it is anticipated, relate largely to the degree of accuracy of the standard instruments used for calibration purposes. It is apparently being left to the personnel of the various undertakings concerned to design apparatus which will provide the wide range of loads required and suitable controlling equipment to enable meter testing to be carried out with the minimum of complication.



Relation between terminal voltage and current through barretter

The ideal source of supply for a meter test room is a battery-driven motor-alternator, for its voltage is stable and under close control. Unfortunately, the cost of such apparatus is relatively high, and will be beyond the means of the smaller authorities. In some instances, at certain periods of the day, meter testing is little short of impossible, due to variation of mains voltage. In order to obviate introducing errors in this way the apparatus here described has been designed to provide automatic compensation for voltage fluctuation. Voltage regulators designed for correction of feeder drop will not, of course, provide the extremely close control which is required for testing purposes. The relay constructed as a result of deliberations upon this problem is sensitive to, and will correct variations of, the order of 0.1 per cent. above or below normal voltage, and while in my opinion this degree of sensitivity is ample there is nothing to prevent greater sensitivity being obtained by certain modifications to the design.

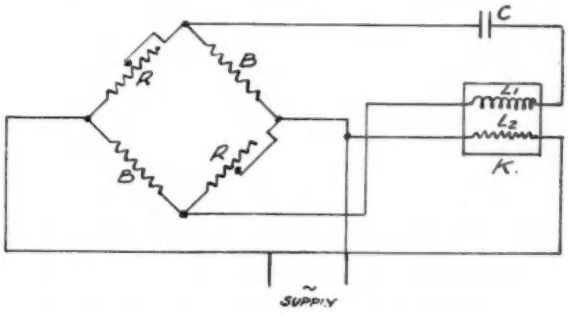
Components of the Apparatus

Briefly, the regulator comprises a sensitive non-ohmic bridge, the arms of which consist of rheostats and barretters of the type employed in series with heaters of indirectly heated filament d.c. radio valves, in order to maintain constant current in their heaters. For a certain range of barretter terminal voltage the current through the barretter is sensibly constant.

The relay employed is a modified single-phase induction meter. The series winding is rewound and connected to the bridge, the potential winding being connected to a source of supply in phase with the current in the bridge. By adjustment of the rheostats in the two arms of the bridge two equipotential points are obtained between the bridge arms when standard normal voltage is applied to the bridge, so that under these conditions no potential appears across the relay winding, and the relay remains inoperative. The barretters maintain the current in each arm of the bridge constant, so that any variation in the voltage of supply appears across the terminals of the rheostats, and hence across the relay winding. An increase in voltage of the supply produces relay operation in a direction opposite to that resulting from a decrease, by reason of the fact that phase reversal takes place between these two conditions. The relay contacts control the grids of two gas-filled relays, which, in turn, control the operation of a small motor driving the compensating apparatus itself. One gas-filled relay produces rotation of the motor in the correct direction for compensating an increase in voltage, while the other provides compensation for a decrease.

Mr. J. Bailey is engineer and manager of the Barnoldswick Urban District Council's undertaking

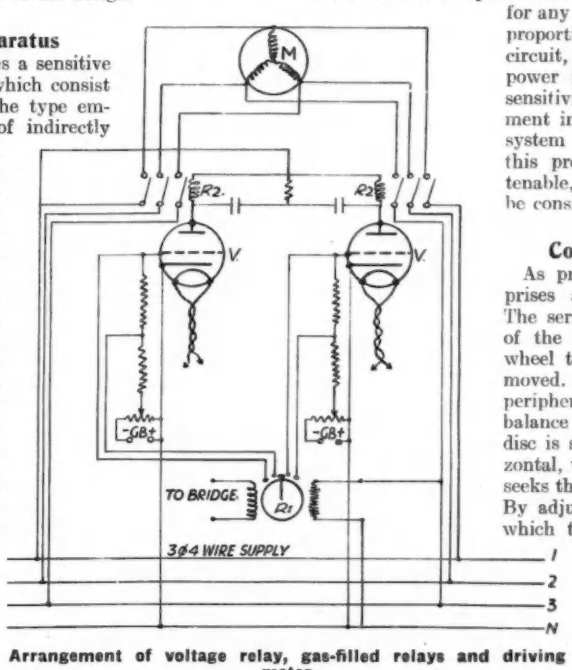
It can be shown that there is a certain critical resistance for the relay winding that will give maximum sensitivity for any given bridge. This conclusion is readily arrived at by algebraic calculation based upon the supposition that the power factor



General arrangement of bridge and relay circuits

B, barretters; R, rheostats; C, correcting condenser; K, voltage relay; L1, series winding; and L2, potential winding.

of the relay winding circuit is unity. This winding is appreciably inductive, and a unity power factor will not be obtained unless correction is introduced. For this reason a condenser is connected in series with the relay, of suitable size to correct the power factor to unity. The available torque for any given voltage variation is directly proportional to the power factor of the circuit, and only by ensuring that unity power factor exists can the necessary sensitivity be obtained. The improvement in sensitivity over an uncorrected system is considerable. Furthermore, this procedure renders the deductions tenable, since ohmic resistance only need be considered.



Arrangement of voltage relay, gas-filled relays and driving motor

GB, grid bias; R1, voltage relay; R2, magnetic relays; V, gas-filled relays; and M, three-phase motor.

Construction of the Relay

As previously stated, the relay comprises a modified single-phase meter. The series coil is rewound on the basis of the foregoing conclusions, and the wheel train and brake magnets are removed. A section is removed from the periphery of the disc (in order to unbalance the latter) and the level of the disc is set slightly out of the true horizontal, with the result that the cut-away seeks the highest point on the periphery. By adjusting the levelling screws upon which the relay is mounted this point can be arranged to coincide with the neutral position for normal voltage, which is situated between the two sets of contacts. By adjusting the distance separating the sets of contacts the inherent time lag of the relay can be set at a position found suitable for the type of fluctuation with which it is called upon to deal. The radius of motion of the moving contact is as small as

possible, in order to obtain maximum pressure at contact surfaces, connection to the moving contact being made by means of a light "pigtail."

It will be observed that the sensitivity is directly proportional to the available winding space on the relay, so that by constructing a specially designed relay with an increased winding space increased sensitivity is obtainable. It would be better if increased torque, rather than increased sensitivity, were aimed at, the brake magnets being retained. This would increase contact pressure and tend to reduce any "bounce" at contacts. Heavier contacts could also be employed.

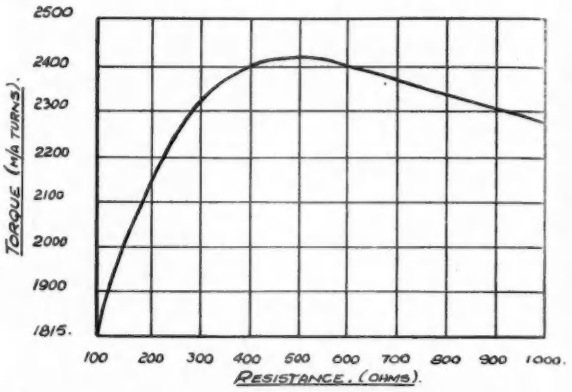
The compensating device itself may be of the resistance type (losses being of relatively small importance) or of the induction type. Of the latter the moving coil regulator is probably more suitable. I believe that a moving coil regulator of an accuracy suitable for meter testing is shortly to be produced, and such a piece of apparatus will be eminently suitable for the purpose outlined. The moving-coil regulator is not so susceptible to variations of load as the resistance type.

A variable resistance has a potential across its terminals which is proportional to the current flowing. For this reason the speed of correction of voltage fluctuation is proportional to the load. The ideal type of regulator is such that the volts drop across it will not vary more than 0.2 per cent. from full load to 1/20 full load. The regulator should not introduce either wave distortion or phase shift.

Adjustment to Conditions

The voltage relay and the compensator should be adjusted to the conditions under which they are intended to operate. In my case the most irritating type of variation of voltage consisted of an almost imperceptible increase or decrease, which took place slowly. This would cause a deviation of the wattmeter reading of the order of, say, twice the thickness of the needle, and very careful attention was required to correct it manually. The relay was accordingly set to correct this variation rapidly. For this reason a large variation of permanent duration took an appreciable time to correct. Fortunately, a variation of this type was found to be comparatively rare. The inherent time lag in the operation of the voltage relay prevented instability due to voltage kicks and surges. The relay is readily adjusted to prevent operation on variations of a permanency less than any predetermined value. The curve showing the relation between the resistance of the winding for a given winding space on the relay and torque (expressed in milliampere-turns) is plotted for an increase in voltage of 0.1 per cent.

The gas-filled relays employed are of a type passing a normal anode current of 0.3 A. The impedance in the anode circuit should be such that the current is limited to a certain safe



Relation between torque and resistance of winding for a given space on the relay

value, in order to prevent damage to the valve. The voltage drop from anode to cathode is about 15 V, depending upon ambient temperature. The magnetic relays in the anode circuit should not be allowed to transmit the shock resulting from their operation to the voltage relay or accumulative "bounce" will occur. The barretters should be screened from direct draughts of air. When sudden large variations in ambient temperature are likely to occur the barretters should be enclosed in a chamber fitted with a thermostatically controlled heater.

Oxidation of Fusible Elements. By G. W. Nicholson

Characteristics of the principal metals employed

THE formation of oxides on fuse elements has a marked bearing on the time necessary for rupturing. Tinting is generally the first indication of the presence of an oxide. The thickness varies, some metals being more subject to this action than others. Very low temperatures sometimes cause considerable oxidation of certain metals and alloys; with some the atmosphere alone is sufficient. In some cases the process may be retarded by initial oxidation, while in others it may become increasingly rapid after the first film of oxide is formed. As oxidation proceeds, the layer becomes thicker and the weight and volume of the original material change.

The extent of oxidation is not only controlled by age under working conditions, time of exposure and temperature, but is dependent also upon the resistance of the oxide formed to cracking. Under certain limiting thicknesses and at certain temperatures, oxygen appears to be able to penetrate oxides, but after the limiting thickness is reached, except possibly in the cases of oxides formed with the less dense metals, the meeting of oxygen and the metal takes place only through cracking.

If splitting did not occur the oxide would in time attain to a thickness sufficient to afford complete protection against further growth. Heating and cooling of the metal, bending and vibration cause minute rifts to appear in the film, and through these the movement of oxygen inwards is freely allowed.

It is seldom that uniformity is found in oxide formation thickness, or that a smooth and regular curve shows the rate of action. Under similar conditions some oxides show a greater tendency to cracking than others, and at high temperatures cracking may be so frequent and regular that a more constant curve is obtained, not showing anything like the spasmodic fluctuations which are common at lower temperatures. On the other hand, at high temperatures, through the storing up of energy in the oxide, large fissures may make their appearance and almost completely break down the oxide barrier between the oxygen and metal. This cracking can only happen, however, when a definite thickness of oxide has been built up.

The extent of cracking caused by heating and cooling is dependent upon the plasticity of the oxide and the difference between the co-efficients of expansion of the oxide and metal. Plasticity increases with temperature and at high temperatures tends to keep low the amount of cracking.

In applying these observations to fusible cut-outs the first point is that the cooler the element the less oxidation will generally take place. Therefore, the higher the percentage of overload which can be allowed the lower will be the temperature under normal working conditions and the less tendency there will be to oxidation.

Different oxides volatilise at different temperatures, some of which may be higher than the fusing temperature of the metal. A layer of oxide may be so strong as to hold up the element after fusion and delay rupture. This is probably more common and dangerous when the element is packed in some powdered material, as in an enclosed fuse. If packed loosely the tendency to hold up will not be so great, but there will be a greater danger of explosion, especially if the powdered material is such that a gas is produced to any extent by the action of the heat of the element on the powder.

Generally the higher the melting point of a non-ferrous metal the less it is subject to oxidation, but there are one or two exceptions, notably silver. The melting points of metals usually associated with fusible cut-outs are:—Copper 1,083 deg. C., silver 960 deg. C., aluminium 660 deg. C., zinc 420 deg. C., lead 327 deg. C., and tin 232 deg. C. Of these, silver is least affected by oxidation and therefore ensures greater constancy of fusing current than the others. But its cost is a bar to its general use, and it is not sufficiently strong mechanically for use with small currents.

In dry air at ordinary temperature little oxidation takes place with the other metals, but all except tin are to a greater or lesser degree affected by moist air. Tin also has little tendency to oxidise at low working temperatures and is in great demand as a protective covering for other metals, particularly copper. At the higher temperatures oxidation may be very rapid.

It is a popular belief that aluminium forms no oxides, but this is not so. If silicon be present to any extent oxidation will be very marked. The first thin layer of oxide formed, however, tends to protect the metal from further oxidation. Copper becomes red hot at 75 per cent. of its fusing temperature and at this critical point a thick scale of oxide is rapidly formed.

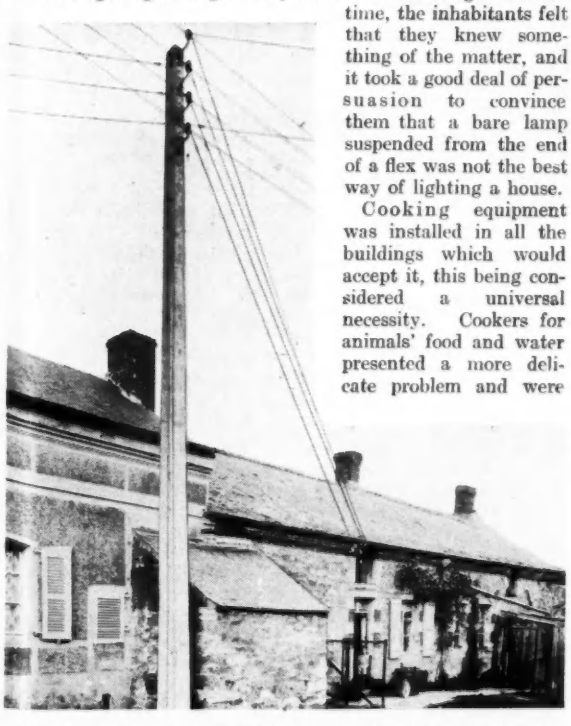
Electrifying a French Village. By S. H. Kahn

A joint experiment

WHAT is possibly the most important experiment in rural electrification and its possibilities which has yet been made in France is now being conducted in the village of St. Hilaire-sur-Helpe, a community of about 900 inhabitants, a short distance from Avesnes. The idea of the experiment is to determine whether, given a chance to try electricity, the average farmer and villager will find it profitable and whether the installation of an electrical system is worth while for the distributor.

The experiment is being carried on co-operatively by the municipality, the Electricité et Gaz du Nord, which holds the electricity distribution franchise, and Alsthom, manufacturers of electrical apparatus. The village was chosen as presenting a typical arrangement, about 83 houses being grouped around the church and the remaining 187 scattered over the surrounding countryside, the largest single group being eight houses. There has been electrical distribution from a small local waterfall since 1910, but this is not sufficient for the lighting needs of the town. The whole installation was, therefore, new. The work involved the construction of six miles of high-voltage and about 19 miles of low-voltage lines, as well as seven substations. The lines are carried by concrete poles. The supply is at 15,000 V, 50-cycle, 3-phase from two main lines. This is stepped down to 115/200 V for the central group and to 230/400 V for the isolated farms.

The experiment involved four separate phases, propaganda, installation, operation and conclusions. The propaganda effort was designed to demonstrate to the villagers that they could obtain greater comfort without greater expenditure by the use of electricity. For this reason the particular needs of each family had to be taken into consideration. Studies showed the possibility of installing about 20 new electric motors of from 1 to 3 h.p. Lighting installations were a more difficult matter. Electric lighting having already existed in the village for some time, the inhabitants felt that they knew something of the matter, and it took a good deal of persuasion to convince them that a bare lamp suspended from the end of a flex was not the best way of lighting a house.



Part of the low-voltage distribution in St. Hilaire-sur-Helpe

Cooking equipment was installed in all the buildings which would accept it, this being considered a universal necessity. Cookers for animals' food and water presented a more delicate problem and were less insisted upon. Radiators for heating also appeared to the population more of a luxury than a necessity, and were therefore placed only in a few of the richer farms. Refrigerators were not "pushed" as they formed too great a novelty for the population.

The propaganda effort was undertaken through a series of three lectures held at the town hall on the benefits of electricity. Through the help of the municipal authorities it was possible to obtain the attendance of the whole population of the village at these lectures. After each lecture a considerable number of consumers were obtained, and personal visits to the "recalcitrant" householders brought about the adhesion of about 80 per cent. of the population before the experiment began. Others have been added since.

The installations were undertaken as rapidly as possible after acceptance by the people of the conditions of the experiment. These are that the installation will be made and the apparatus lent them cost free for one year. At the end of this period each householder decides whether he will keep the equipment and pay for it, or whether he prefers to return it. All electricity used is paid for at the usual rates of 1.72 fr. per kWh for lighting and 0.50 fr. for power.

After installation demonstrators visited each house to show the housewives how to use the equipment. When possible this demonstration took the form of sending an expert into the home to prepare a full meal for the family, such as the housewife would normally prepare herself. Every effort was made to keep these demonstrations within the range of the daily needs of the population. In the installation of equipment, also, each case was specially studied and such appliances were chosen for each house as would be most likely to give extra comfort without an unnecessary strain on the family budget.

A typical cottage showing the small cooker with auxiliary hot-water arrangement, a refrigerator, and the distribution board

It is, of course, too early yet to say what the results of the experiment will be. For the greater part of the inhabitants it will not end until the close of 1937 and for those who have had installations put in since the beginning of the scheme it will be a little longer. The fact that some of the most conservative villagers are being converted to electricity by the experience of their neighbours is considered a good sign.

House Heating

FOR studying the heat requirements of, and the behaviour of heating systems in, the experimental house at the Building Research Station, Garston, near Watford, Messrs. A. F. Dufton and W. G. Marley used electric convection radiators (which warmed the air of the rooms, with screens to minimise radiation) placed against the inner (windowless) walls during the winter of 1928-29. The experiment was repeated with the heaters placed under the windows during the winter of 1934-35. The rooms of the house were used as laboratories throughout, care being taken to avoid undue interference with the investigation. Allowance was made for the heat contributed by the occupants of the rooms. The investigation (described in the *Journal* of the Institution of Heating and Ventilating Engineers, May, 1933, and January, 1937) showed that although the heat requirements varied considerably from day to day, the daily amount was closely correlated with the average outside shade temperature. The heat requirement of one room was $4.14\ (65-T)$ kWh per day, where T was the average outside temperature. A eupatheoscope in the centre of the room showed that when the heaters were placed against the wall opposite to the windows the temperature immediately in front of the windows was 2 deg. F. less than at equivalent positions from the inner wall opposite. When the heaters were placed below the windows the temperature was substantially the same everywhere. Thus, there was no significant difference between the heat required in the two cases. The temperature of the window glass was 44 deg. F. in each experiment, indicating that the heat loss was the same in each case.

Phase Shifting. By G. W. Stubbings, B.Sc., A.M.I.E.E.

Spheres of application of potentiometer devices

POTENTIOMETER devices are largely used in electrical testing for production of a continuously variable voltage. When a three-phase supply is available such devices can be used to obtain variation of the phase as well as of the magnitude of a testing voltage. The inherent disadvantage of a single potentiometer resistance unit used in this way is that the magnitude of the test voltage changes as its phase is varied, although the circuit can sometimes be arranged so that small phase shifts can be obtained without sensible change of the magnitude of the voltage. By using two or three potentiometer resistance units the magnitude as well as the phase of the testing voltage can be brought under complete control, and an arrangement of this kind has recently been proposed as an automatic phase-shifting device for a three-phase kVAh meter.

A Simple Arrangement

The simplest phase-shifting arrangement is shown in fig. 1, where a slider rheostat is connected to two of the terminals A and C of a three-phase supply and the testing voltage is obtained from the third terminal B of the supply and the adjustable contact D of the rheostat. If the rheostat and the circuit connected to B and D are all non-inductive, the vector of the voltage on BD is obtained by a simple geometrical construction. Let ABC represent the triangle of the vectors of the supply voltage. Divide AC at the point D in the ratio of the conductances of the two segments of the rheostat determined by the adjustable contact, g_1 and g_2. Divide the line BD in the ratio $(g_1+g_2)/g_3$, where g_3 is the conductance of the test circuit connected to the terminals B and D. Then, if O is the point of division of BD, OB represents in magnitude and phase the vector of the test voltage. Point D on the vector diagram also represents to scale the position of the movable contact of a rheostat in which the resistance between two points is proportional to the distance between them.

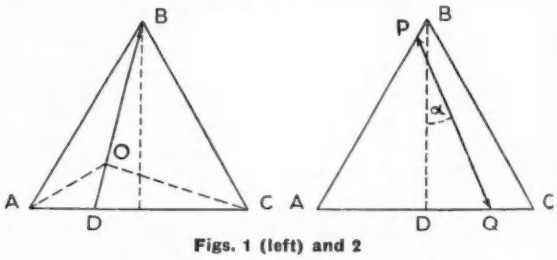
This construction leads to the result that the phase of the testing voltage depends only upon the physical position D of the adjustable tap on the potentiometer unit, and is independent of the resistance of the test circuit. The magnitude of this test voltage, however, depends upon the ratio k of the resistance of the test circuit to that of the potentiometer rheostat. If the line voltage of the three-phase supply be considered to have a value of unity, it is easy to show that, for a balanced-voltage system, the test voltage with the tapping point D at the half-way position is equal to $\sqrt{3/2}\ 4k/4k+1$. If n represents the fractional shift of the tapping point from this position, then for small values of n the change in the value of the test voltage is approximately proportional to n^2. The phase shift is evidently equal to arc tan $2n/\sqrt{3}$. When the factor k is large, the magnitude as well as the phase of the test voltage is given by the vector BD, and a range of phase shifts of about 11 deg. each side of the central position BD can be obtained by movement of the sliding adjustable contact of the rheostat on each side of the central position by a factor of about one sixth without the magnitude of the test voltage varying by more than 2 per cent. This method is, therefore, useful for making final phase adjustments when an approximately correct phase position of the testing voltage can be obtained by other means.

If the test circuit is inductive the star-connected load represented by the rheostat and the test circuit is electrically similar to that obtained in the Varley test for phase sequence. In this condition the vector of the test voltage will not lie in the line BD but in a segment of a circle constructed upon it and having an angle equal to θ, the phase angle of the test load. The phase of the test voltage is no longer defined by the position of the adjustable contact of the rheostat, but depends also upon the ratio of the impedances of the test load and of the rheostat. If this ratio is large, the magnitude of the test voltage, for positions of the adjustable contact of the rheostat nearly central, will be approximately represented by the voltage whose vector is BD, and this test voltage will be displaced in phase from BD by an angle which is sensibly constant.

Another Method

An arrangement whereby the phase of a testing voltage may be varied over a whole cycle without change in magnitude is shown diagrammatically in fig. 2, representing three potentiometer rheostats connected between each pair of line terminals of a three-phase supply. Considering this figure as a vector diagram as well as a diagram of connections, then any two points, such as P and Q which define positions of two of the adjustable contacts on the rheostats, will also define the vector of the potential difference between these points, provided that no connection of finite impedance is made to them. Consider the reference voltage thus derived to that between the terminal B and the mid-point position of the rheostat connected to A and C. Then it is easy to work out the positions of the adjustable contacts to give a voltage equal to this reference voltage, but displaced in phase by a stipulated angle α, the three-phase voltages are balanced. Let the segments of the resistances of the rheostat determined by P and Q be defined by the fractions m and n. Then in the vector triangle one angle is 60 deg., the second angle is $90-\alpha$, and the side PQ must be equal to $\sqrt{3/2}$. The required number of elements of this triangle are, therefore, known, and it can be completely solved by elementary trigonometry, for the quantities $\sqrt{3/2}$, m and n are, respectively, proportional to sin 60°, cos α and sin $(30+\alpha)$, whence, α being given, m and n can be calculated.

The foregoing argument applies to the limiting case in which no current is taken from between the points P and Q. If a test circuit of finite impedance is connected to these points, this current will tend to reduce the voltage between these terminals to a value less than that represented by the vector PQ. If the test circuit and the rheostat units are all non-inductive, the vector of the test voltage corresponds exactly in phase with the ideal vector PQ. The magnitude of this test voltage bears to that of the voltage, represented by PQ, a ratio which is equal to $G_1G_2/G_1G_2+g_3(G_1+G_2)$ where G_1 and G_2 are the sums of the conductances of the segments of each of the potentiometer rheostats determined by the positions of the adjustable contacts, and g_3 is the conductance of the test circuit. The sum of the conductances of the segments of a unit is the least when the adjustable contact is in the central position, and the greatest when this contact is at the extreme positions. If the positions of the movable contacts of the rheostats are fixed on the assumption that the resistance of the test circuit is infinite, then, with a finite resistance, the actual test voltage will be unaffected in phase, but will vary in magnitude, being least when it is in quadrature with either of the line voltages, and greatest when it is phase with either of the line voltages.



Figs. 1 (left) and 2

Voltage Variation

An automatic potentiometer phase-shifting device does not, therefore, give a constant voltage if the positions of the tapping points on the rheostats are calculated according to the simple geometrical formula given above. The variation in the magnitude of the voltage depends upon the ratio of the resistance of the test circuit to that of the potentiometer units and to keep the variation within 2 per cent., this ratio should be at least 8. If the test circuit is inductive, or if the supply voltages are unbalanced, the phase of the test voltage will not correspond to that given by the geometrical construction.

As a means for varying the phase of a test voltage manually the three potentiometer method has the practical disadvantage of difficulty of manipulation. When one of the movable contacts is near the middle position on the rheostat, small adjustments can be made without much variation in the magnitude of the testing voltage. If, however, one or both of the contacts are remote from this middle position, small adjustments of phase require compensating adjustments to maintain constancy of test voltage. This practical disadvantage has made the modern phase-shifting transformer, although more costly than a set of potentiometer rheostats, a far more convenient method of varying the phase of a testing voltage.

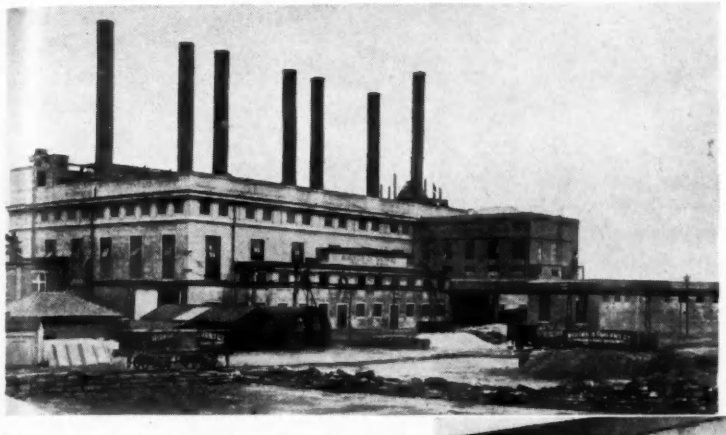
Former London Engineering Students

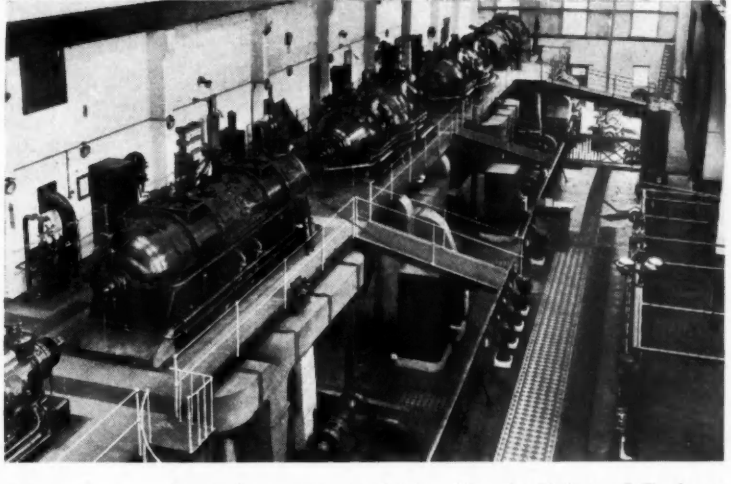
The University College Engineering Society proposes to issue an annual handbook and journal for circulation among all old students of the College Engineering Department. Accordingly the Society is anxious to get together an up-to-date list of members, and old students are asked to send in their names, addresses, years at College, academic and professional qualifications, present appointment, and news of their contemporaries to Mr. P. H. Walker, Engineering Department, University College, Gower Street, W.C.1.

The Watford Extension

A 15,000-kW Brush-Ljungstrom set

THE 15,000-kW extension to the generating plant at Watford power station, which is to be inaugurated to-day by Lord Derby, brings the capacity of the station up to 36,000 kW. A turbine with a m.c.r. of 15,000 kW, when stop-valve steam conditions are 250 lb. per sq. in. gauge and 750 deg. F., has been installed. By raising the pressure to 300 lb. the most economical rating could be increased from 12,000 to 14,400 kW without mechanical alteration.





Left: The Watford Corporation power station. Below: The turbine hall

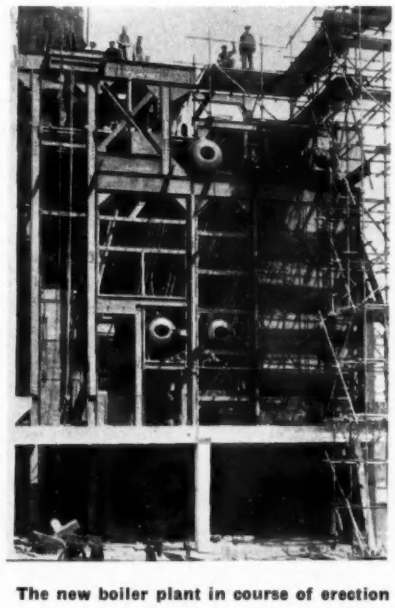
Like the five existing sets of from 1,850 to 7,000 kW the new turbine is of Ljungström design, and comprises two rotors revolving in opposite directions giving relative blade speeds twice the running speed of 3,000 r.p.m. The blade system consists of one group of radial-flow reaction double-rotation blading and two parallel groups of two-stage single-rotation blading. Horizontal blades in the h.p. group are fixed in thirty-five concentric drum-shaped rings secured alternately to the faces of two discs so that the two sets of rings are interleaved. The low-pressure axial-flow moving blades are mounted on the outer peripheries of the discs and the fixed guide blades are carried in a ring that contains the complete blade system.

A 7,000-V, three-phase, 50-cycle alternator on each end of the turbine casing is driven by the blade discs which are attached to spindles overhung from the inner bearing of one of the alternator rotors. The turbine casing and alternator stators are bolted together to form one tubular structure and the end casings carrying the outer bearings are in turn bolted to the stators. The whole weight is carried by the condenser.

A centrifugal spring-loaded governor, worm-driven from one of the alternator rotor shafts, controls the throttle through a pressure relay system which is either electrically or manually adjusted. Lubrication is supplied under pressure by a geared valveless rotary pump, a steam pump being used when the set is started or shut down; the latter functions automatically if the oil pressure falls below a predetermined value.

The turbine exhausts into a two-flow "Delas" condenser with a surface of 11,000 sq. ft. For maintaining a vacuum at full load of 28.75 in. Hg. (Bar. 30) some 10,750 gal. of circulating water per min. at 55 deg. F. is required. This is provided by two Drysdale pumps driven by 73-h.p., 730-r.p.m. motors. Each pump will deliver 7,100 gal. per min. against 20 ft. head.

Air and vapour are withdrawn by a two-stage ejector. Two-stage bleeding in conjunction with surface heaters give a final condensate temperature of 200 deg. F. Extraction water pumps of the "Pervac" vertical type driven by a 19-h.p. motor can deal with 292 gal. of condensate per min. against a head of 95 ft. (including vacuum) at 1,440 r.p.m. Air for the closed-circuit cooling system of the alternators is supplied by two Sturtevant fans each with a duty of 21,000 cu. ft. per min. against 12½-in. total w.g. at 1,420 r.p.m.; these require 66 h.p. each, but the two motors are rated at 100 h.p in order that one fan when used alone may deal with 30,400 cu. ft. of air per min. against 6.6-in. which calls for 88 h.p. Air after leaving the alternators is cooled from 148 to 95 deg. F. by passing over nests of tubes (Premier Boiler and Engineering Co.), through which 250 gal. of water per min. at 80 deg. F. is circulated. Ellison's motor control gear and Alley and McLellan l.p. sluice valves are employed.



The new boiler plant in course of erection

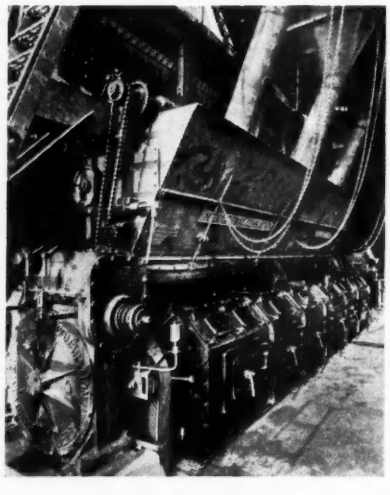
The boiler feed pump is of the pluro-vane type by Mather and Platt and is designed to deal with 160,000 lb. of water per hr. at 200 deg. F. against 300 lb. per sq. in. when running at 2,930 r.p.m. It is driven by a 100-h.p. Brush induction motor.

In order to provide for the increased short-circuit capacity under the new conditions, 6.6-kV metal-clad switchgear with a rated duty of 500,000 kVA has been installed to the specification of Messrs. Preece, Cardew and Rider in collaboration with Mr. A. W. Barham, the chief engineer and general manager of the undertaking. This switchgear has been installed in a separate switch-house and is electrically operated from a new control room. It consists of seventeen panels of the compound-filled horizontal draw-out type, two of which were ordered by the Central Electricity Board. Thirteen of the circuit-breakers are fitted with cross-jet explosion-pot contacts; twelve of them are rated at 800 A and the other at 1,800 A. The other four are of 3,000-A capacity. The equipment includes 3,000-A duplicate bus-bars and oil-immersed isolators which are motor-operated, but only when the bus-bar coupler is closed.

The switch-house is divided into three sections by fireproof screens and all cable ducts are sealed. Change-over from the old cubicle type gear was carried out under load. The steel-cubicle control board of "V" formation is fitted with indicating instruments and relays of the flush-mounted type. Along its top is mounted an illuminated mimic diagram with dummy aluminium-strip bus-bars, coloured lights showing when the breakers are closed, open or automatically tripped. Interlocks prevent synchronising under incorrect circuit conditions. On the control desk, four panels are allocated to exciter controls and one to engine room telegraphs and telephones.

The new boiler is of the same type as the older ones, but considerably greater evaporation is obtained for the same floor space. Its normal evaporative capacity is 80,000 lb. per hr. (m.c.r. 100,000) as against their 30,000 lb.

Two upper drums are connected to two lower drums by 3¼-in. vertical bent tubes providing a boiler heating surface of 10,220 sq. ft. The combustion chamber has positive-circulation water walls on all sides with a heating surface of 1,280 sq. ft. Steam conditions at the boiler stop valve are 250 lb. per sq. in. and 800 deg. F., the superheater being of the "McPhail" loop type suspended between the front and second bank of boiler tubes. The gilled-tube "Foster" economiser of 3,360 sq. ft. and the "Usco" plate-type air heater of 16,965 sq. ft. (which is designed to reduce the flue gas temperature from 450 to 250 deg. F.) can be by-passed in emergency or on low loads, the boiler being then operated on the natural draught furnished by a mild-steel chimney. Balanced draught is obtained by means of forced- and induced-draught fans, the latter incorporating scroll grit arresters with secondary "Vortex" cells. An overall efficiency of 86 per cent. on gross calorific value at normal rating is expected. Complete arrangements for the collection and disposal of flue dust from boiler, economiser and air heater are included.



The "L" type stokers

The mechanical stoker follows precedent at the station in being of the twin "L" type, the effective grate area in this case being 336 sq. ft. In normal operation preheated forced draught will be employed, but this can be dispensed with on light loads. Air for combustion passes through both upper and lower runs of the grate on its journey to the furnace, thereby cooling the grate surface and reducing radiation loss from the lower run. A secondary air system includes a high-pressure fan with distribution ducts and nozzles. Four-speed oil-bath constant-mesh gear units direct coupled to the twin front shafts of the stoker are chain-driven from shafting in the basement.

The principal contractors included: Brush Elecl. Engineering Co., turbo-alternator and condenser; Metropolitan-Vickers Electl. Co., switchgear and control room; Alton Battery Co., battery; John Thompson Water Tube Boilers, boiler, steam pipes and separator; Stewarts & Lloyds, boiler feed pipes and valves; Bagshawe & Co., coal elevator; International Combustion Co., mechanical stokers and airheaters; James Howden & Co., mechanical draught and grit catchers; E. Green & Co., economiser; Morris Singer & Co., control room overhead lighting.

For the twelve months ended last month, 58,500,000 kWh was sold to 25,000 consumers. Both figures are nearly double those recorded six years ago, but the gross revenue of £222,000 is only about one-third more. The area of supply includes those of the adjacent local authorities and is bounded by the territories served by the North-Met. and Chesham and Colne Valley Companies and Luton Corporation.

Nitrogen-filled Cable for the Grid

THE gas filled cable of which a mile is to be installed in connection with the 132-kV grid (see Ninth Annual Report of the Central Electricity Board) is a development of Messrs. W. T. Glover & Co., Ltd. In its manufacture the conductor after stranding is passed through a solid die in order to smooth out corrugations and to provide a flat bed for two or three thin metallical papers. The latter screen the interstitial spaces between the wires in the outer layer of the strand, present a smooth cylindrical surface to the dielectric, and limit any gas space within the dielectric to that of the thickness of its individual papers. The dielectric consists of pre-impregnated papers applied in air and varying in thickness from 1¾ mils at the conductor surface to 5¼ mils at the outer dielectric screening; both the lays and gaps are normal, the latter being 3 to 6 per cent. of the paper width. A 3-mil copper tape, applied with overlap, screens the outer boundary of the dielectric and a lead sheath comes over this with a 20-mil diametral clearance. A copper wire-woven fabric over the lead sheath provides a bedding for two metallic reinforcing tapes, and over these come either a second lead sheath or else a non-fibrous tape both with protective tapings. Single-core, three-core S.L. or three-core screened cables can be made; in the last case the conductors can be shaped for economy.

After the cable has been laid and jointed, the interior of the first lead sheath is charged with dry nitrogen to 200 lb. per sq. in, gauge *via* gas-feeding glands near the sealing ends and then shut off by a valve. The cable subsequently operates as a normal solid type without ancillary apparatus. It is claimed that no ionisation can occur, at any conductor temperature up to 100 deg. C., even with a voltage twice that for which the cable has been designed. The maximum gas-pressure so far employed is 200 lb. per sq. in. gauge, at which the operating maximum stress can be designed for 85 kV per cm. Sufficient gas space is provided within the sealed off sheath to limit the pressure rise, due to expansion of oil with temperature, to a value within the elastic range of stress of the reinforced lead sheath. No drainage of compound from the pre-impregnated dielectric takes place at 100 deg. C.

Stability tests carried out on cables laid and jointed under service conditions with the following exaggerated features produced no sign of ionisation or other track: (a) Forty-two days at 140 kV per cm. (max.) with daily temperature cycles up to 70 deg. C. conductor temperature; (b) nine months with an internal gas pressure of 350 lb. per sq. in. with the same daily temperature cycles; and (c) one hundred and twenty days under stability test conditions at 112 kV per cm. (max.) with daily temperature cycles up to 100 deg. C. conductor temperature.

A stability test was performed on a 132-kV 0.2 sq. in. single-core cable with 0.65 in. radial dielectric with gas pressure at 200 lb. per sq. in. and 1.1 times working voltage continuously superimposed. The cable was subjected to three 18-hr. temperature cycles per week with maximum conductor temperature of 85 deg. C. and power-factor-voltage tests were taken at the cold temperature three times weekly up to twice working voltage, at which no sign of ionisation was detected. Power-factor-voltage tests were also taken up to 850 deg. C. and up to twice working voltage. The p.f. temperature curve was practically flat up to 85 deg. C. as was the p.f. voltage curve at 85 deg. C., at which the absolute p.f. value was 0.31 per cent. After seven months, the cable and its four sealing ends (two outdoor) and a joint showed no signs of deterioration or ionisation.

The 132-kV cable for the Central Electricity Board is single-core with conductor section of 0.3 sq. in. screened with two perforated and one unperforated impregnated metallised papers giving a diameter at this stage of 0.715 in. Over the first sheath the diameter is 2.25 in. and over the second 2.550. After the cable has been compounded, lapped with 15-mil Guttaroid (non-hygroscopic), taped with 50 per cent. overlap, cotton taped, compounded-pressure taped, compounded and whitewashed, the overall diameter becomes 2.740 in.

Swedish Co-operative Lamp Manufacture

An agreement is reported to have been made between the International Lamp Manufacturers' Trust and the Swedish C.W.S. bulb factory "Luma," regarding collaboration in technical research, in return for which the "Luma" concern has agreed not to sell its products elsewhere than in Co-operative stores. Before 1928 the International Trust had complete control of the Swedish lamp market and its price policy gave rise to complaint. The central Swedish C.W.S. body, Kooperativa Forbundet, asked the Trust to quote more reasonable prices, but this was of no avail and towards the end of 1928 the K.F opened a Co-operative lamp factory with the support of the organisations in Finland, Norway and Denmark. This resulted in the price of ordinary lamps being reduced from 1.35 kronor to 0.80 kronor, and the Trust was forced to follow suit. In the autumn of last year the price of "Luma" lamps and those manufactured by the Trust were 0.90 kronor. Under the provisions of the new agreement a suit brought against "Luma" for patent infringement is withdrawn. The "Luma" has consented to certain restrictions of its markets and also to undertake such raising of prices as are warranted by general changes of production costs. "Luma" will furthermore have to contribute certain annual sums to a common research pool. A Co-operative lamp factory which is planned in Scotland in collaboration with "Luma" will also be affected by the arrangement.

Air Drying for Switchgear. By R. R. Belbin

AIR-DRYING plant of the silaca gel type is well known for its varied applications. It is extensively used in this country and in America for dehydration and air-conditioning, both industrial and domestic, and in conjunction with refrigeration.

Silica gel as an agent

In any type of switchgear where air stagnation is likely to exist trouble may be experienced due to moisture in the air. Where this condition exists it has been found advisable to provide means for introducing cold dry air, thus eliminating the possibility of moisture depositing on the vital parts of the gear.

Silica gel, as a drying agent, lends itself particularly to this field of application, as the operation of the plant can be entirely automatic. There are no possibilities of the carrying over of foreign bodies from the dryer to the gear. The gel is clean and safe to handle and, once installed, requires little attention and, furthermore, does not require renewal as it is possible to regenerate it for further use.

This absorbent is a manufactured substance obtained from the reaction of sodium silicate and sulphuric acid. The jelly-like substance so obtained is cleaned, dried and subjected to special heat treatment. The final product is a glassy, but light, and highly porous substance. Due to the extremely small dimensions of the pores the internal structure is not exactly known, as it is difficult to observe them even by optical means. As silica gel contains such a large pore surface it has a correspondingly great absorbing capacity and it is stated that the normal commercial variety will absorb approximately 50 per cent. of its own weight of water from saturated air. The process of absorption is that of capillary attraction, but, due to the minute porosity, it has a far more powerful absorption capacity than any natural product.

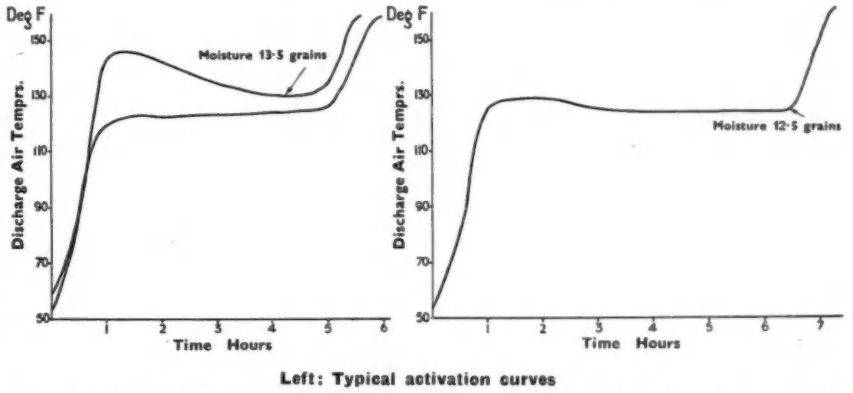
For some time I have had the opportunity of checking the operation of a small plant installed for the purpose of supplying cold dry air to outdoor-type switchgear. The parts to which the air is vented include e.h.v. contact chambers and various link boxes for secondary cable connections, all of which are subject to moisture deposition.

In the schematic diagram the valves A, B, C and D are mechanically linked together and operated as a whole by means of a "Thrustor." Change over from one unit to another is arranged by an electrically driven time switch set to operate at a predetermined time daily. The dryer is designed to give an output of 1,000 cu. ft. of dry air per hour throughout a period of twenty-four hours from either one of two absorbers.

As one of the two units is placed on load to supply the dry air the other is automatically taken off load for reactivation. When this process is complete it is stopped by cutting out the appropriate fan and attendant heater.

Activation is carried out by passing air through a heater, raising the temperature of the air to approximately 400 deg. F., and then passing it through the silica gel bed, finally venting the vapour driven off to atmosphere. The activation period will depend on the condition of the gel when taken off load, but generally five to six hours has so far been found to be an average time.

The flat parts of the activation curves represent the periods during which water is being driven from the silica gel. The sudden rise in temperature at the end is the completion of regeneration and consequent lowering of the water content in the exhaust air. The data are obtained from temperatures

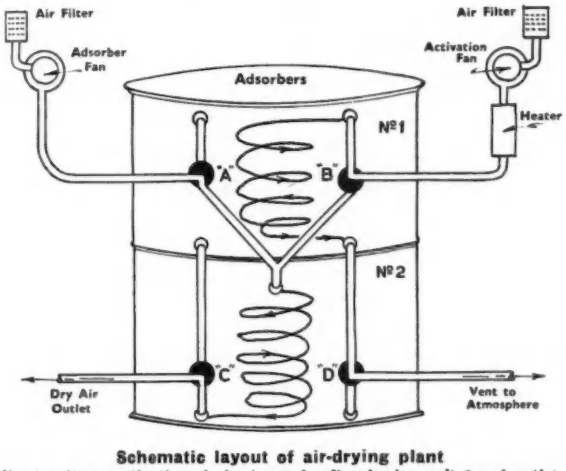


Left: Typical activation curves

Load period 24 hr. Condition at end of period, humidity 3 per cent., moisture 0.1 grains per cu. ft. Activation period 5 to 6 hr. Heater temperature 415 deg. F.

Right: Extended activation

Load period 30 hr. Condition at end of period, humidity 5 per cent., moisture 0.3 grains per cu. ft. Activation period 7½ hr. Heater temperature 395 deg. F.



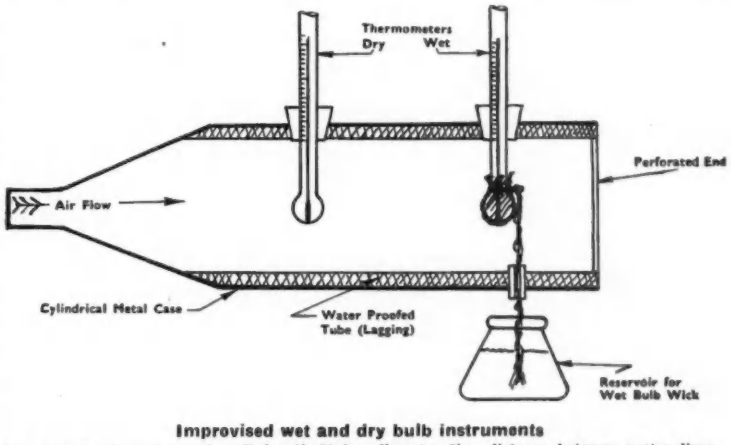
Schematic layout of air-drying plant

No. 1 unit on activation via heater, valve B, adsorber unit 1 and outlet pipe to valve D. No. 2 unit on air conditioning via valve A, pipe to inlet unit 2, and to gear through valve C.

AIR CONDITIONS.

Atmospheric			Fan suction	Adsorber discharge			Pipe line			
Temperature	% Humidity	Moisture	Temperature	Temperature	% Humidity	Moisture	Temperature	% Humidity	Moisture	Dew point
52	57	2.4	57	69	7	0.6	52.75	12	0.6	Under 30
51	68	2.8	54	69	7	0.6	54	12	0.6	"
61.5	76	4.5	63	82	8	0.9	61.5	15	0.9	"
53	78	3.5	53	70.25	10	0.9	53	19	0.9	"
44.5	81	2.7	52	68	8	0.6	46	17	0.6	"
52	87	3.7	51	70	6	0.4	52	10	0.4	"
45.5	89	2.8	52	67	5	0.4	46	13	0.4	"
45	96	3.3	52	67.75	8	0.6	44	14	0.5	"
51	96	4.1	50	68	10	0.8	51	19	0.8	"

Moisture content expressed in grains per cu. ft. Temperature deg. F.

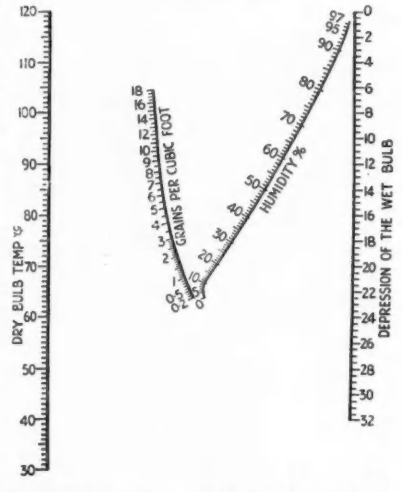


Improvised wet and dry bulb instruments

Approximate dimensions: Overall length 7½ in., diameter 2in., distance between centre lines of thermometers, 2¼in.

at the outlet end of the exhaust pipe as it vents to atmosphere.

While the plant is housed in a brick-built shelter, no special precautions are necessary to ensure that atmospheric conditons do not enter the building. The table on page 505 gives a few actual operating figures picked out at random from a series of tests and will clearly demonstrate the efficiency of this drying medium. The fact that each absorber before going on load stands idle at least seventeen hours prior to its change over further proves its capabilities. A period of idleness after activation is advisable to allow the gel to cool. During the tests shown in the table the plant was operating at approximately its designed duty and the readings were taken at the end of the 24 hours' load period.



Hygrometric chart, ventilated dry and wet bulbs

To obtain certain of the data it was necessary to make up an improvised wet- and dry-bulb instrument and, as a definite flow of air was available, the apparatus illustrated was devised. Its use apart from testing plant of this nature may be apparent and perhaps it may serve a useful purpose in other fields of investigation. While no claim is made for its being a precision instrument, it serves to take practical comparative tests. In an endeavour to simplify calculations, reference tables and curves a nomogram was compiled which also may serve a dual purpose.

The values for humidity may exhibit a discrepancy when compared with certain other tables, but it must be remembered that the conditions are not comparable with, say, wet- and dry-bulb readings taken in a Stevenson screen. Again, values of humidity below 10 per cent. are rather problematical and it will be found, if comparison is made, that it is at these low values that discrepancy occurs. Values at which the depression of the wet bulb is such as to give readings below 30 deg. F. should not be considered or taken from the nomogram. In this case special tables should be consulted. When conditions as low as these exist little anxiety need be felt with regard to moisture content, as at 32 deg. F. the moisture content of air at saturation point is only 2.1 grains per cu. ft.

What might be termed a stationary type of silica gel plant is the now prominent "breather" as used for transformers, &c., which is easily regenerated. All that is required to dry or activate a breather charge is to place the complete inner container in an oven and heat it to a temperature of 300 to 400 deg. F. By impregnating the standard granular silica gel with cobalt chloride the condition of the charge becomes immediately discernible. When dry and in the active state a deep blue colour is observed, which changes to a whitish pink when saturated with moisture. After heat treatment the blue colour is restored, indicating complete regeneration of the unit. When a charge is activated, and before it is cooled off, the lids provided should be replaced and sealed off with adhesive tape. The charge may then be kept in store for an indefinite time till again required in the breather.

Improved Sound Film Reproduction

The "Mirrophonic" system

TECHNICAL refinements in cinematography have resulted in the achievement of a greater degree of perfection in the recording on the film-edge of accompanying speech and sound effects than in their reproduction. Varying degrees of compensation are claimed for several recently introduced systems. Among them is the "Mirrophonic" method (of American origin) now made available to British theatres by the Western Electric Co., Ltd., London.

The superiority of this system results from its fuller response to the much broader sound-frequency band now being imprinted on talking films, coupled with its greater volume range capacity. The quality of the sound is thereby definitely enhanced, enabling speech to be reproduced with remarkable fidelity. Apart from new components of advanced design, existing theatre equipments may be modified or added to for improving performance. The new sound heads, fitted to the picture projectors, do not employ constant speed sprockets, but depend on a kinetic scanner for pulling the film at a uniform speed past the light beam. This is an inertia controlled drum with ball bearings maintained at constant speed by means of a special double flywheel incorporating a mechanical filter which suppresses any oscillation that might be transmitted to the scanning drum by the uneven passage of the film.

The lens tube focuses the image of the exciting lamp filament on the sound track, thereby dispensing with the usual mechanical slit. The photo-electric cell compartment is located on the door of the sound head compartment. No p.e.c. amplifier is employed, for the output is taken to the main amplifier *via* an output transformer mounted in the sound head and a combined volume control and change-over control cabinet.

Two optical systems are available. In one case the "optical bridge" differs from the usual scanning methods inasmuch as the beam of light from the existing lamp is applied to the film on the celluloid side of the film. A microscope is focused on to the sound track on the emulsion side of the film to magnify the image on the track and project it on to a large masking slit and collimating lens which, in turn, focuses the light passing through the slit on to the photo-electric cell. This method of scanning results in low "ground" noise and a greater efficiency at high frequencies. These new sound heads are driven by 110-V 50-cycle motors.

A new range of amplifiers, all a.c., employ for the first time in sound equipment an important new device termed a "harmonic suppressor." This may be compared to an electrical governor which automatically causes the amplifier to maintain constant quality, free from distortion, over an output range so large that the loudest sounds heard in the theatre may exceed the weakest by more than 100,000,000 times.

All circuits can be checked by means of a selector switch associated with a meter graduated to read percentages of the normal value. The smallest of the three amplifiers has a gain of 92 db and an output of 8 W. Contrary to usual Western Electric practice, it does not employ a push pull final stage, but has three resistance capacity coupled stages. The first two valves are pentodes and the last is a new valve with an oxide coated filament rated at 5 V and 1.2 A. With the anode taking 60 mA at 325 V the valve is capable of delivering 8 W speech output. The harmonic content of the audio output is minimised by employing reverse feedback in the amplifier. Compensation is also made in the amplifier for higher-frequency scanning losses.

The intermediate size amplifier has four stages, the first three resistance capacity coupled, while the output stage is push-pull utilising two valves. The output is 15 W, the gain being 98 db. The gain frequency characteristic is flat from 50 to 12,000 cycles, and this amplifier has its own power supply built in. The high power single stage push pull model is used with an intermediate amplifier in large theatres. It has a gain of 10 db and an output of 50 W; additional amplifiers can be added in parallel. The plate voltage for its two valves is supplied by two built-in high voltage mercury vapour half-wave rectifier valves (a.c. at 105-115 V 50 or 60 cycles).

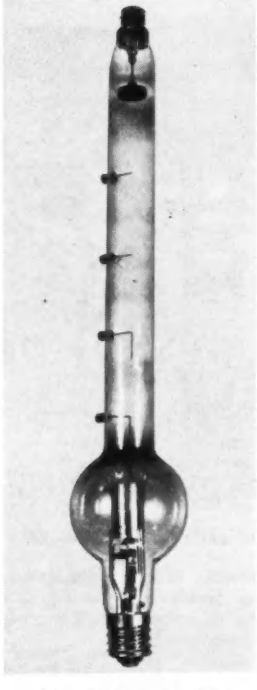
A new "di-phonic" loudspeaker horn system, as developed by Dr. Harvey Fletcher, of the Bell Telephone Laboratories, for two-way auditory perspective, employs a low frequency combination of baffle and dynamic speaker of the cone type for the reproduction of frequencies below 300 cycles, and a cellular horn with one or two dynamic units for the reproduction of the higher frequencies. Both the cellular horn and the low-frequency speaker have energised fields (1A at 25 V) supplied from a "Tungar" bulb rectifier. The speech input is distributed to the two speakers by means of a dividing network which introduces attenuation of approximately 12 db per octave above and below the cross-over frequency of 300 cycles.

An electronic regulator between the main amplifier and reproduction combines the functions of volume magnifier and fader. It prevents the introduction of noise due to amplifying sound currents at their source; controls theatre volume in nineteen steps; avoids interaction between reproducer sets by means of a special "off" position; and materially aids smooth change over from one projector to another because the volume level of each machine can be pre-set. The quick-acting change-over switch itself is of a spring-operated cam type.

An Electric-discharge Stroboscope

RECURRENT movements can be apparently slowed down, or arrested, if they are illuminated with intermittent light flashes arranged to occur at the appropriate frequency. The definition obtainable depends upon the shortness of the duration of the flash of light, hitherto obtained by the aid of flicker discs or small neon lamps; but thermal lag in such devices affects the clarity of the image.

The British Thomson-Houston stroboscopic tube is an electric-discharge flashing light source specially developed for overcoming this condition. The tube has a bulbous end in which are the cathode and its heater, their common connection to a G.E.S. cap being the screwed shell, to which should be connected the anode load circuit. At the other end of the tube is fitted a standard bayonet lamp cap, both contacts of which are connected to the anode. Four starting electrodes are brought out to small cylindrical caps on the side of the tube. The tube has a low pressure mercury-vapour filling, and thus gives light of a bluish-white colour.



The stroboscopic tube

The anode needs 1 A (r.m.s.) at from 100 to 260 V, peak, depending on the duty cycle. The maximum frequency of flash is 500 per second and its apparent duration 10 microseconds, depending on the operating circuit, which should be arranged so that the anode current return lead to the cathode is taken to the shell of the G.E.S. screw socket.

It is most important that a switch be inserted in the anode circuit of the tube, and that it be not closed until the cathode has been energised for approximately 15 minutes. The cathode is indirectly heated, heat shielded, taking 10 A at 5 V, and the method of operation entails the passing of high peak currents (250 mA). Therefore, unless the cathode has reached its correct operating temperature the tube will be damaged. The correct operating temperature of the tube will be obtained if it is inserted in a reflector with a glass cover to retain some of the heat which is normally dissipated by it.

For contact operation the circuit shown in fig. 1 will provide from 0 to 3,000 flashes per minute. There is an optimum point for the cathode potential slider for each frequency of flash. This circuit gives one flash only, irrespective of the time the contacts remain closed. Higher frequency of flash (but with reduced intensity) can be obtained by reducing the value of the condenser. For low speed of flash the 2,000 and 1,250 ohm resistances can be increased, keeping the ratio the same, and in this way the current through the operating contacts is reduced. In fact, the supply can be taken from small h.t. batteries, provided a high frequency of flash is not required. If a.c. is not available, the cathode can be supplied from accumulators, but great care must be taken that the accumulators do not discharge and cause the tube to operate at a subnormal cathode voltage.

Fig. 2 shows how the flash can be controlled by the frequency of an electrical supply, representing a constant value with large inertia. By varying the sliders of the 100 and 5,000 ohm resistances an optimum point of definition will be obtained, and the time constant of the circuit can thus be adjusted to avoid the obtaining of two flashes per cycle of supply. The tube acts as a rectifier and thus gives one flash, which is of very short duration, for each complete cycle of the supply voltage.

With two circuits of this nature, connected with opposite polarity to the a.c. mains, the flashes from the two tubes can be arranged at 180 deg. to one another, with a variation of some 45 deg. in the relative phase position of the flashes. Two movements can thus be viewed in different colours by the use of a neon tube in one of the circuits.

The circuit shown in fig. 3 will provide from 250 to 500 flashes per second with the standard mercury tube, but is not very stable and is only convenient for laboratory use with skilled control. It is not easy to ascertain the actual time of flash or the definition obtainable. The time of passing of current by the tube is much longer than the apparent visual definition. The general position of a line 0.002 in. broad marked on a rotating disc can be determined when it is travelling at 2,000 ft. per min.

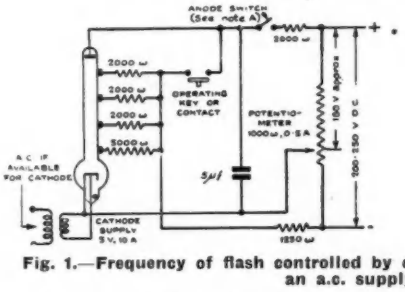


Fig. 1.—Frequency of flash controlled by operation of a key or contact.

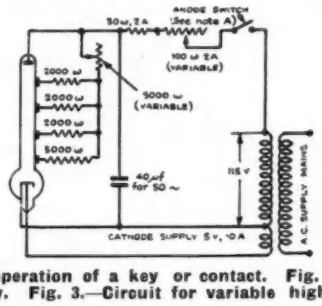


Fig. 3.—Circuit for variable high-frequency flash

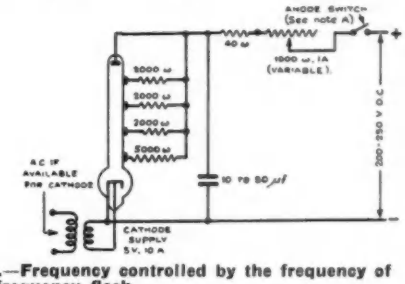


Fig. 2.—Frequency controlled by the frequency of an a.c. supply.

Correspondence

Contributions from readers are welcomed. The writer should give his name and address, not necessarily for publication

Electricity Supply Finance

In his second letter (in your issue of March 19th) Mr. Ratcliffe apparently realises that the figures which he put forward originally did not accurately represent the cost which a normal power plant could achieve for the conditions stated. He now states that the plant in question is a process-steam plant. While this may alter the value of the figures, it does not justify the jeer at the national grid scheme in his original letter and makes his criticism even more unwarranted. Experienced engineers have always realised that public supply cannot compete with the costs of power from a process-steam plant, where the power and steam demands are reasonably well balanced. This is a special case and represents only a small fraction of the total power demand of industry.

In his second letter Mr. Ratcliffe states that selected station undertakings are in a sheltered position, and implies that such undertakings are getting the whole benefits of the grid scheme. Speaking in general terms, up to the present the only undertakings to receive financial benefit from the grid are those which take their supplies on the grid tariff, and these undertakings will benefit further as they increase their load, due to the reduction in the standing charge for the increase.

At the moment the selected station undertakings are practically all taking their supplies under Section 13 of the 1926 Act, *i.e.*, at a cost at which they could have generated their own supplies had the Act not been passed, although it is the use of their plant together with the grid which enables the tariff takers, such as Mr. Ratcliffe's own undertaking, to secure financial benefit. It is to be expected that as the load of the country grows, the selected station undertakings will start to share in the financial benefits accruing under the grid scheme, but they, unlike the tariff takers, have to wait for their share.

The penultimate paragraph of the second letter appears to suggest that the selected station undertakings should not only receive no benefit from the grid, but that they should pay more than their own costs to enable tariff-taking undertakings to receive their supplies at a price lower than the true incidence of cost; in other words, the selected station undertaking

should subsidise the tariff-taking authority. The McGowan Report suggests another way of dealing with the matter, and whatever one's views on this, I feel sure it would be preferred to Mr. Ratcliffe's suggestion.

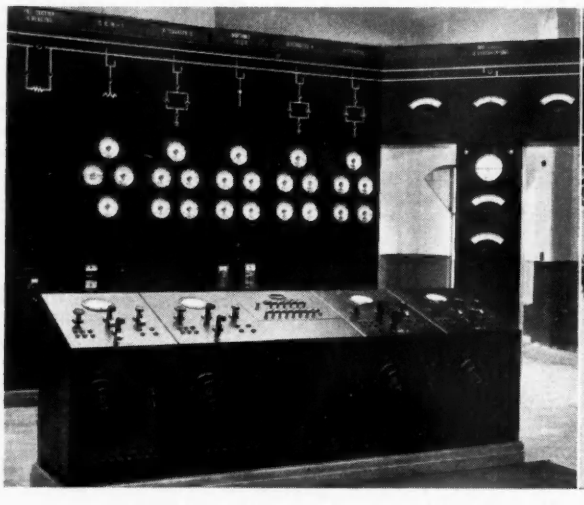
Mr. Ratcliffe seems obsessed with the idea that it is the cost achieved by private power plants that dominates power tariffs. I would suggest that while such costs are interesting, they really have nothing to do with the case. The price at which power supply can be given is governed entirely by the costs incurred by the undertaking in giving the power supply. If a supply can be given at a lower cost than that incurred by a private plant, we can get the power load; if the cost is higher than that of the private plant, then we are better off without it. It is fundamentally wrong to subsidise one class of consumer at the expense of other classes. Tariffs must be based on costs if reasonable equity is to be given to all an undertaking's consumers.

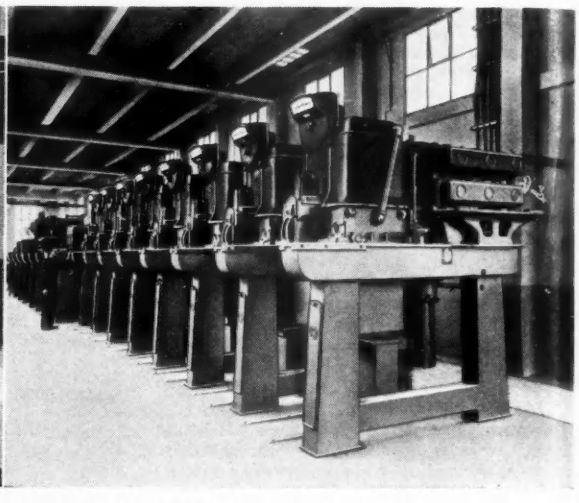
With regard to his remarks about diversity, it is the higher value of diversity which automatically comes into being with the larger undertaking, which is the main factor in reducing the cost of supplies to all classes of consumers.

Reverting to the original letter, Mr. Ratcliffe must admit that, if he had his own generating plant, he could not take on the power load outlined by him at the price stated. He must also admit that the grid tariff is lower than his own generating costs would have been. I submit that he has no reasonable grounds for complaint, and, therefore, his tilt at the grid scheme is both unwarranted and ungracious.

J. N. WAITE,
General Manager and Engineer.

Hull, *March 22nd.*





The Watford extensions (see page 503). Left: The main control desk. Right: The 6.6-kV main switchgear

Conditions in Nyasaland

I have applied for a situation as engineer for a Nyasaland tea factory to take charge of a power house and factory machinery with the aid of semi-skilled native labour, and I would be much obliged if you or your readers could give me an idea as to the salary appropriate to a situation of this nature and in this district.

A furnished house is provided and must therefore be taken into consideration. EMIGRANT.

March 15th.

Bombproof Structures

In your leading article of March 26th, under the heading of "The Nerve Centre," you mention Sir T. Inskip's suggestion that switchboards, &c., should be made bombproof as a precaution against air attack.

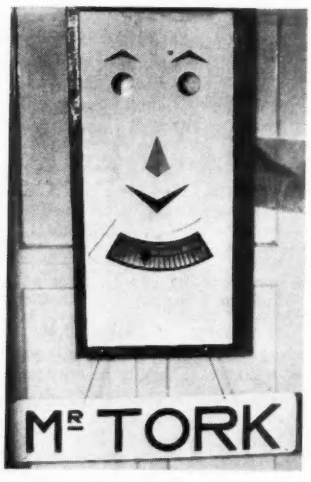
Marine engineers have raised with me the question as to the possibility of automatically closing valves to isolate sections of steam pipe lines in the event of their being fractured by concussion. In the latter event a stokehold would rapidly fill with steam, when it would be impossible for fires to be withdrawn until damage had been done to the boilers, or the ship would become helpless until the damaged pipe had been repaired. It was, therefore, required that the presence of live steam in the stokehold should cause actuation of the thermal releasing device. Obviously, the thermal means employed must be suitable for resisting considerable mechanical strain and be capable of withstanding the normal vibration experienced in bad weather.

It would appear that similar conditions might apply in the case of power stations if bomb-concussion caused a serious fracture in any part of the steam-pipe system. When remote-operated steam valves are to be closed under emergency conditions, a supply of electricity may not be available, and consequently the heat from the steam is the best means for actuating the valve trip gear. A thermal device employed for giving an alarm when propeller-shaft bearings overheated withstood similar vibration and mechanical strain, and its application to steam valves has been suggested. A. G. BULLEN.

Liverpool, *March 29th.*

The E.P.E.A. in Kent

THE Electrical Power Engineers' Association (Kent Section) annual dinner was held at Ashford on March 20th, the section chairman, Mr. N. V. Waters, presiding. The Mayor of Canterbury (Alderman F. C. Lefevre), proposing "The Electricity Supply Industry," said that those in charge of undertakings should take a long view, but should not be extravagant in expenditure on mains. More attention should be paid to making people electrically minded. Mr. H. Hall (borough electrical engineer, Gillingham), responding, said that unless the supply industry brought the cheap supply made available by the grid to everyone the grid would be a failure, but this would probably be prevented by an Act that would follow the McGowan Report. Mr. W. H. Steele (superintendent control engineer, C.E.B., Bankside), who also responded, stated that it was only three years since the Board commenced operations on a large scale in the South-East England area, but during the past year 60 per cent. of the total kWh generated was produced by the four largest stations at a fuel cost of about 0.11d. Mr. H. Wilson (borough electrical engineer, Ashford), who proposed "The Association," said that before they organised many shift engineers worked 56 hours a week for 25s. But for the E.P.E.A. their remuneration would be probably less than half what it was at the present time.



Speech limiting device used at the E.P.E.A. dinner. (See comment on page 494)

Replying, the president of the Association, Mr. H. J. Cox, said they were out to make the industry the most prosperous in the country.

The general secretary, Mr. W. A. Jones, who also replied, urged that expenditure on mains should be increased. The industry should be regarded as a national service, and the charges in the country should be the same as in the towns. Mr. Waters proposed "The Visitors," and, in response, Mrs. Gregory, chairman of the Electrical Association for Women, said that they hoped electricity would prove as advantageous to women in the home as it had already proved to industry. The Chairman of Ashford Urban District Council, Mr. P. H. Jones, also replied. Mr. F. E. Allen, section secretary, proposed "The Dinner Committee," and Mr. P. R. Caister responded. Dancing followed.

New Apparatus and Devices

for Domestic, Cooking and Heating, Lighting, Power and Scientific Purposes

Combustion Control

An instrument developed by ELLIOTT BROS. (LONDON), LTD., Connington Road, Lewisham, S.E.13, at the instance of Mr J. W. Reber, is believed to be the first constructed to give a direct reading of the chimney loss. Its operation is based on the tendency of two moving coils, fixed together at an angle and lying in a non-uniform magnetic field, to take up a position depending on the ratio of the currents in the two coils.

In the simple circuit employed *a* is a Siemens CO_2 measuring equipment operating on the thermal conductivity principle, which produces an e.m.f. proportional to the CO_2 content of the flue gases; *b*, *c*, are thermocouples in the flue and air inlets, and *e*, *f*, are the two electrically-distinct moving coils.

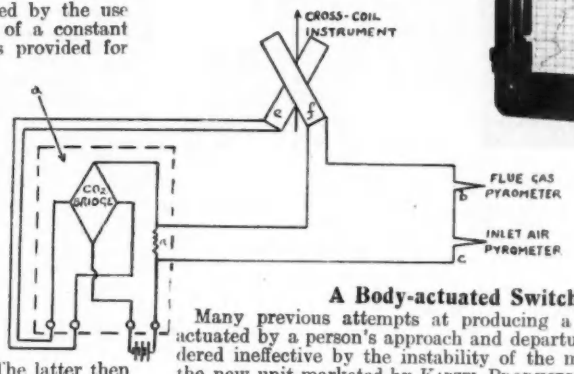
A direct reading cannot generally be obtained by the use of resistances in the coil circuits, an addition of a constant to one of the e.m.f.s being required. This is provided for the resistance *r* in the current lead to the CO_2 transmitter. As the current is constant the potential difference across *r* is also constant.

The instrument employs the standard mechanism of a Siemens continuous temperature recorder having a chart speed of 20 mm. or 60 mm. per hour, with chopper bar and inked ribbon.

Separate high-sensitivity temperature or CO_2 indicators or recorders, may be connected to the same equipment. An indicator is necessary on the CO_2 side for setting the "air zero" of the CO_2 transmitter. The air-inlet thermocouple may be omitted if the temperatures of the inlet air and at the instrument terminals are assumed to be equal. The latter then constitute the "cold junction" of the thermo-electric circuit.

Current is preferably supplied by a transformer and Westinghouse rectifier from a.c. mains. Battery operation is practicable, but not connection to d.c. mains, as this would call for special insulation between the cross coils.

An accuracy well within one per cent. of the chimney loss is claimed. The most important advantage over separate CO_2 and temperature indicators lies in the increased significance imparted to a comparatively small movement of either of the simple indicators. For instance, if the flue-gas conditions change from 12 per cent. CO_2 and 250 deg. C to 10 per cent. CO_2 and 300 deg. C., the increase in the loss from 14 to 20 per cent. may be more than one-third of the length of the recorder scale, whereas the CO_2 and temperature indicators would show movements amounting to only one-tenth to one-eighth of the scale lengths.



The Elliott combustion control showing recorder and circuit diagram

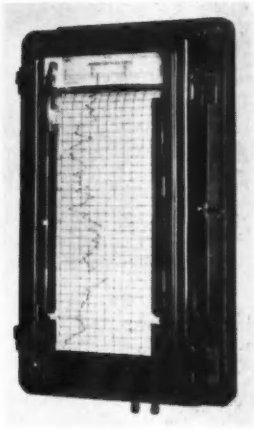
Vacuum Cleaners

A new "Goblin" vacuum cleaner known as the "Monarch" and an improved "Wizard" model are announced by the BRITISH VACUUM CLEANER AND ENGINEERING CO., LTD., Parsons Green Lane, London, S.W.6.

In the case of the former machine a novel combined vibrator and power-driven brush permits even more thorough cleaning of carpets and rugs with minimum wear. The mounting of the motor on rubber in a double casing gives quiet running. A simple earthing device is available. The machine is easily portable and the handle is provided with patent cable cleats. Both flex and handle can be instantly removed for transport. A complete set of accessories is available.

The "Goblin Monarch" and "Wizard" vacuum cleaners

Like the "Monarch" an external bag type machine, the new "Wizard," or the "Coronation Wizard" as it is called, is now even more adaptable, especially for use in the small home. By the simple removal of the handle the machine is converted immediately into a hand cleaner for such purposes as stairs, bedding, upholstery and car interiors. A larger capacity bag is used than on the old machine and improvements to the upholstery nozzle ensure the picking up of hairs, &c. All attachments can be quickly fitted, a special long-arm fibre extension rod giving the cleaner a total length of 6 ft. for out-of-reach cleaning. To facilitate servicing the terminal block and switch have been arranged as a single unit mounted in the casting.



A Body-actuated Switch

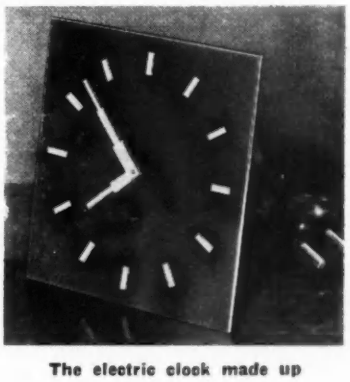
Many previous attempts at producing a switch which is actuated by a person's approach and departure have been rendered ineffective by the instability of the mains voltage. In the new unit marketed by KAPZEL PRODUCTS, LTD., 12, Whitehall, London, S.W.1, a new principle involved is claimed to overcome this disadvantage.

The essential features are a 3-ft. brass rod aerial, a specially designed receiving valve mounted on a pedestal about 18 in. from the ground, and a control box. In the base of the aerial support is a transformer which raises the potential of the aerial to 4,000 V. The effect of an approaching body is to increase the capacitance and so cause the receiving valve to operate a relay situated in the base of the pedestal. This relay actuates a mercury switch in the control box, which also houses a potentiometer for setting the apparatus to its most sensitive condition.

One of the most obvious uses of the apparatus is for switching on and off window display lighting as a person passes by. The standard unit, which will handle a load of 15 A, is suitable for a window up to 12 ft. in length and is actuated up to 4 ft. from the glass. Both the aerial and receiver can be easily concealed among the goods displayed. The apparatus, the loading of which is only 12 W, also lends itself admirably for such uses as burglar alarms. It is supplied for a.c. only.

An Electric Clock Kit

The latest development by the LONDON ELECTRIC CLOCK CO., LTD., 15, Park Street, London, N.1, is a kit-set electric clock which can be built by the amateur experimenter and installed in radio cabinets, bookcases, cupboards, &c. The parts are supplied with a clearly numbered blue print and instructions.



The electric clock made up

Small Enclosed A.c. Motors

BROOK MOTORS, LTD., Empress Works, Huddersfield, announce that their range of totally enclosed surface cooled synchronous a.c. motors has been extended by the introduction of new frame sizes from 2 h.p. to 1½ and 1 h.p. at 1,500 r.p.m. in the three-phase type. These motors are designed for use in damp or very dusty positions.

Lighting Fittings

To their extensive range of table and floor standards BENNETT & Co., 13, Sackville Street, London, W.1, have added a number of models incorporating attractively coloured glass tubing, those in amber and peach being especially effective. Another innovation is a range of fittings with the central support bound with fine rope.

E

An "Easy-fix" Flange

The SIMPLEX ELECTRIC CO., LTD., Credenda Works, Oldbury, has introduced a flange for rapidly fixing an electric circulator or immersion heater into a hot-water tank after cutting a single hole.

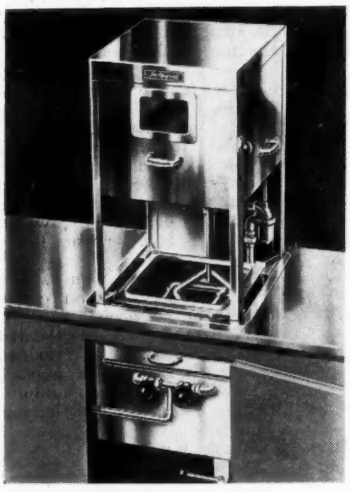
The Creda "Easy-fix" flange

A 3-in. hole is first drilled in the tank. The top lock nut and washer are removed from the flange, the hinged halves of the bottom socket are swung together, and, with the top ends held between thumb and finger, the flange is sunk into the tank. The halves are then opened on the hinge until the flange is in place in the hole, when it can be locked by means of a special key, and the washer and locking nut assembled.

The circulator can then be screwed into the threaded flange and locked tight thereby ensuring a robust and watertight joint, and, at the same time enabling an existing hot-water tank to be electrically heated.

Dish-washing Machines

Four new dish-washing machines produced by the HOTPOINT ELECTRIC APPLIANCE CO., LTD., 24, Newman Street, London, W.1, will cover the whole range of requirements, from the large private house to the largest hotel or restaurant. The smallest model, the D. 15, measuring 51 in. by 19½ in. by 21½ in., is suitable for up to fifty persons, while the D. 20 and D. 30 are designed for 50-150 and 150-300 persons, respectively. The largest machine, the D. 60, consists essentially of two D. 30 models in tandem.



The Hotpoint "D20" dish-washer

The principle of operation is the same for all models. Dirty pieces are loaded into trays and passed through the machine, being washed and rinsed in two separate operations both of which are controlled by one lever. The lower section of the machine acts as a storage tank for the washing water, which is forced by an electrically driven pump (the motor of which is mounted above the washing chamber in a sealed compartment) through the wash arms. Heated above and below the dishes, these arms are given a radial movement by the reaction of the water and produce a powerful spray which is claimed to remove the most obstinate grease or dirt.

Rinsing is carried out by hot water (a temperature of at least 180 deg. F. is necessary) drawn straight from the mains. It is directed on to the dishes from above and below through very fine nozzles in two fixed U-shaped arms. The rinsing water falls into the washing-water tank, and not only helps to restore heat lost but creates an overflow, carrying away grease from the surface.

It is possible to arrange for any two of the doors to be counterpoised.

An Anti-dazzle Lamp

The fact that one can look at it for an indefinite period without discomfort (and read a newspaper immediately afterwards), that an untouched photograph of it shows no halation and that objects placed in front give no shadow at all, speaks well for the anti-dazzle properties of a new type of lamp just placed on the market by the WALMSLEY PATENT LAMP CO., LTD., 180, Gray's Inn Road, London, W.C.1.

Models are available for street and public lighting, industrial purposes and also for automobiles, both for use as head lamps and fog lamps. In every case the principal involved is the same, namely, the breaking up of the light from the lamp into innumerable rays by means of the company's patent "Jewel" diffusing lens, which consists of minute glass crystals between double cylindrical, conical, or convex clear glass sheets. In spite of right-angle diffusion being attained the lamps have remarkable penetrating qualities, a feature which make them especially suitable for street light and automobile use.

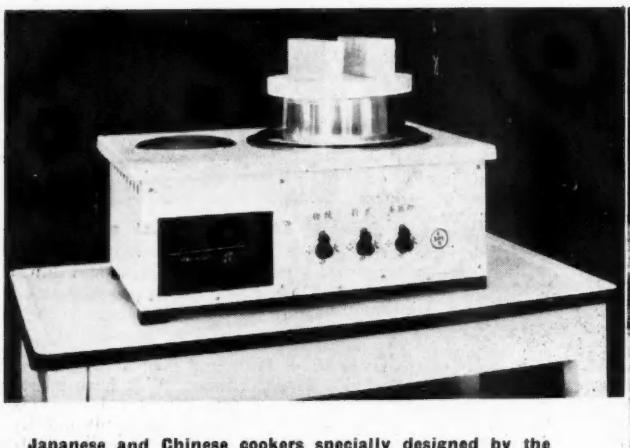
The "Walmsley" lamp

The type designed for street illuminating is claimed to have a 90 per cent. lighting efficiency. Special attention has been paid to facilitate cleaning and beneath the cast-iron dome there is an extra heavy steel canopy with storm cover. It is supplied vitreous enamelled in various colours. The industrial type fitting is particularly useful when working to fine limits and is claimed to eliminate eye-strain completely.

In order to provide a permanently deflected yet full driving beam a section of the front diffusing lens of the motor head lamp has been left clear and a second conical diffusing lens placed over the lamp inside.

Electric Cooking in the East

THE Shanghai Electric Power Co. has designed special electric cookers for use by Chinese and Japanese consumers. They have built-in rice bowls and frying bowls, and are fitted with Westinghouse Electric International quick-acting metal-clad "Corox" elements. Our illustrations show a small Japanese cooker equipped with a 1,200-W element, 1,500-W rice bowl, 1,600-W griller, and 600-W appliance receptacle; also a Chinese cooker with the rice bowl cover removed to show the rice pan while the fry-bowl cover has been taken off to show the 1,200-W element.



Japanese and Chinese cookers specially designed by the Shanghai Electric Power Co. for its consumers

Australian Electrical Imports Rise

Share of the United Kingdom

During the trading year ended with June last imports of electrical machinery and appliances into Australia continued the recovery which started in 1931-32 and totalled £3,361,000 in value, an increase of about 30 per cent. on the previous year and three times the 1931-32 figure. Details of the principal groups, extracted from the recently issued official returns of the Commonwealth Government, are given below, together with a note of increases or decreases compared with the previous year. It will be noticed that the latter are very few. The decline shown in radio material came after a very large advance in 1934-35, and left last year's total still above that of 1933-34. Except in this group and the telephone group the share of the United Kingdom has been well maintained.

With regard to future prospects for the electrical trade generally there are two conflicting influences. On the one hand a number of promising extension schemes entailing the supply of power plant and telephone material are either mooted or under way, but on the other hand local manufacture is extending from the smaller and simpler types of apparatus to certain of the larger and more complicated classes of equipment.

	1935-36. £	Inc. or dec. over 1934-35. £
Dry cells—		
Total	5,240	+ 2,130
From United Kingdom	3,100	+ 1,900
„ United States	2,100	+ 300
Storage batteries for radio sets—		
Total	650	+ 370
Storage batteries for motor vehicles—		
Total	1,610	+ 4,440
From United Kingdom	1,110	+ 400
„ United States	500	— 3,920
Other batteries and parts—		
Total	16,200	+ 2,200
From United Kingdom	3,470	— 4,630
„ United States	12,400	+ 6,600
Cables and wire (cotton covered)—		
Total*	9,290	— 1,710
Cable, telegraph and telephone, paper-insulated, lead-covered—		
Total	20,200	— 8,800
From United Kingdom	3,920	— 1,580
„ Germany	14,400	+ 12,600
Other telegraph and telephone cable—		
Total	89,400	+ 79,100
From United Kingdom	85,800	+ 79,100
„ Germany	3,040	— 360
Light and power cable, paper-insulated, lead-covered—		
Total*	40,800	+ 17,900
Other cable and wire—		
Total	744,000	+ 154,000
From United Kingdom	671,000	+ 149,000
„ United States	31,000	+ 7,000
„ Germany	12,000	— 1,000
„ Canada	4,000	— 3,000
„ Japan	8,500	+ 200
Carbon manufactures—		
Total	58,700	+ 3,900
From United Kingdom	16,500	— 4,500
„ United States	13,700	— 2,500
„ Germany	14,300	+ 2,000
„ France	2,800	+ 100
Motors under 1 h.p. (separate)—		
Total	94,000	+ 45,500
From United Kingdom	45,600	+ 22,600
„ United States	36,800	+ 17,600
„ Germany	3,900	+ 1,100
Induction coils, h.v.—		
Total	9,100	— 7,300
From United Kingdom	2,500	— 1,400
„ United States	5,800	— 3,500
Fans, electric—		
Total	29,500	+ 16,600
From United Kingdom	7,100	+ 3,100
„ United States	14,700	+ 11,200
Circuit-breakers or switch units above 15,000 V. or 250,000 kVA rupturing capacity—		
Total	70,400	+ 22,700
From United Kingdom	50,600	+ 3,400
„ Switzerland	19,700	+ 19,700
Voltage regulators, etc.—		
Total	14,000	+ 4,200
From United Kingdom	10,100	+ 4,500
„ Switzerland	2,800	+ 1,300
Liquid slip regulators, etc.—		
Total	20,500	+ 3,500
From United Kingdom	8,000	— 1,200
„ Germany	9,500	+ 4,100
Relays—		
Total	12,700	+ 8,200
From United Kingdom	3,500	+ 1,500
„ United States	7,800	+ 6,300
Dynamos, a.c., induction—		
Total	125,000	+ 52,000
From United Kingdom	85,000	+ 36,000
„ United States	14,700	+ 2,900
„ Sweden	17,100	+ 8,500
Dynamos, a.c., variable speed, commutator type—		
Total*	10,400	+ 2,300
Dynamos, a.c., other—		
Total	61,500	+ 18,100
From United Kingdom	45,300	+ 5,800
„ Germany	10,200	+ 8,200
D.c. traction motors—		
Total*	1,900	+ 200
Motors for gearless lifts—		
Total*	4,700	+ 2,200
Other d.c. dynamo-electric machines—		
Total	136,800	+ 69,100
From United Kingdom	81,000	+ 39,800
„ Germany	32,400	+ 20,300
„ United States	13,600	+ 3,000
Other dynamo-electric machines—		
Total	28,000	+ 4,500
From United Kingdom	16,500	+ 3,200
„ Germany	1,500	— 900
„ United States	9,400	+ 3,200
Alternators for turbines	40,200	+ 28,000
Convertors, motor and rotary—		
Total	12,200	+ 9,500
Lamps, filament, automobile—		
Total	55,000	— 7,500
From United Kingdom	24,500	+ 6,400
„ Japan	1,000	— 500
„ Holland	26,400	— 11,300
Lamps, under 20 V, including torch and flashlight—		
Total	25,000	—
From United Kingdom	9,800	— 1,000
„ Japan	3,000	+ 400
Lamps, 20 V, and over, gasfilled—		
Total	84,000	+ 9,000
From United Kingdom	78,600	+ 12,600
„ Holland	2,250	— 2,750
Lamps, 20 V, and over, other—		
Total	37,200	— 4,800
From United Kingdom	28,700	— 2,600
„ Japan	4,200	— 3,800
Fittings and accessories—		
Total	29,100	+ 4,300
From United Kingdom	17,300	+ 3,300
„ Germany	2,000	+ 200
„ Japan	5,700	—
„ United States	3,600	+ 900
Switches, fuses, cut-outs, etc.—		
Total	88,100	+ 27,200
From United Kingdom	51,500	+ 22,100
„ Germany	4,800	+ 2,400
„ United States	25,200	+ 7,100
Heating, cooking and domestic appliances—		
Total	32,400	+ 16,300
From United Kingdom	19,500	+ 12,800
„ United States	2,300	+ 100
„ Canada	10,100	+ 3,300
Measuring and recording instruments—		
Total	122,000	+ 33,000
From United Kingdom	67,000	+ 20,000
„ Switzerland	12,500	+ 1,500
„ Germany	13,600	+ 4,600
„ United States	23,700	+ 5,300
Regulating, starting and controlling apparatus—		
Total	93,500	+ 30,500
From United Kingdom	62,600	+ 26,600
„ United States	25,000	+ 1,100
Static transformers under 66,000 V—		
Total	8,300	+ 3,500
From United Kingdom	4,800	+ 2,400
„ United States	1,300	+ 200
Static transformers, over 66,000 V—		
Total*	25,400	+ 13,000
Telegraph instruments and appliances—		
Total*	19,000	+ 4,500
Telephones—		
Total	115,500	+ 64,000
From United Kingdom	98,000	+ 50,500
Telephone switchboards and appliances—		
Total	328,000	+ 175,400
From United Kingdom	251,000	+ 116,000
„ Sweden	7,200	+ 700
„ United States	66,000	+ 60,400
Vacuum tubes, electrical—		
Total	13,300	+ 5,700
From United Kingdom	1,400	— 400
„ Holland	2,300	+ 400
„ United States	9,200	+ 5,500
Radio valves—		
Total	276,000	— 51,000
From United Kingdom	77,000	— 40,000
„ Holland	93,000	+ 25,000
„ United States	101,000	— 34,000
Radio receiving sets, accessories and parts—		
Total	52,800	— 26,800
From United Kingdom	13,000	— 13,400
„ Holland	—	— 3,500
„ United States	29,000	— 15,000
Electrical appliances, n.e.i.—		
Total	216,000	+ 60,000
From United Kingdom	137,000	+ 49,000
„ Canada	3,200	+ 1,800
„ Germany	5,200	+ 800
„ United States	53,600	+ 900
„ Japan	3,200	— 1,300
Electrical ware of earthenware, including insulators—		
Total	32,300	+ 12,500
From United Kingdom	16,900	+ 13,200
„ Germany	4,900	— 300
„ Japan	2,400	+ 900
Electrical insulating paper and boards—		
Total	20,500	— 3,900
From United Kingdom	15,500	— 400
„ United States	3,500	— 2,700

* Mainly from United Kingdom.

Electricity Supply in China

Progress and Prospects

Considerable progress has been made in China in the past few years in the production and distribution of electricity. This is particularly true in the large centres in which industry is concentrated and which consume about 80 per cent. of all the power used in the country. Probably the main reason for the improvement is the institution in 1928 of a National Construction Committee intended to supervise the electrical industries in all China.

The situation which this committee found was not an encouraging one. Free distribution of electricity amounted to 70 per cent. of the total used in Canton, for example, while in Peiping and Tsinanfu the figure reached 60 per cent. Thefts of electricity also were frequent, especially in the systems operated by Chinese firms, while difficulties of transport for fuel and material, a slavish following of routine methods, the custom of building with the cheapest equipment obtainable interfered with the proper operation of the plants while nepotism was rife.

The action of the Committee was in the first place directed to obtaining a concentration of the plants. Considerable numbers of power users preferred to run their own stations rather than use the distribution companies' services, and even where these existed the size of the systems was on the whole very small. Thus as late as 1935 there were only twelve stations with a capacity of over 10,000 kW, while thirty-six were rated at between 1,000 and 10,000 kW. On the other hand there were ninety-six plants with capacities between 100 and 1,000 kW, and 316 had a capacity of less than 100 kW. This concentration is, of course, slow, but is being carried on steadily.

The Committee has also built a testing laboratory for the examination and approval of all material before it is installed and has standardised both material and system of supply: the standards for the latter are 50 cycles and 220/380 V, and these standards are now applied in about 80 per cent. of the Chinese distribution systems. Another action of the Committee which has contributed to encouraging electrical development is the enforcing of rate cuts when profits rise above 25 per cent. on the invested capital. The power distribution franchises have also been standardised with grants for a period

of twenty years, and the Government is empowered to take over the plant at the expiration of the franchise. At Hangchow and Chishuyen the systems have already been taken over; in the latter town this has enabled the free distribution of electricity to be reduced to 15 per cent. Government plants are not always free from difficulties, however. For example, at Canton the Committee found in 1931 that only 30 per cent. of the electricity distributed was being paid for, and this at the rate of only 20 cents Chinese per kWh.

It is estimated that 20 million h.p. of hydraulic energy is available, but only a very small part of the electricity produced is from water-power sources—about 1 per cent. In 1934 there were eight privately owned and two publicly owned hydro-electric plants in the country with a total capacity of only 2,200 kW. Compared with this there were seventy-eight privately owned and ten publicly owned steam stations with a capacity of 476,000 kW, and sixty-two private and two public plants with a capacity of 64,000 kW, operated by combustion engines.

There are two main reasons for this. In the first place the cheapness of labour and the widespread distribution of coal in China makes this fuel very cheap. In the second, the investments involved in the construction of dams and important hydraulic works for an uncertain financial return, as well as the difficulties in the way of constructing high-voltage lines has so far discouraged enterprise in this direction.

Another problem which the Chinese distribution industries have to face is the securing of consumers. Outside of the large centres where electricity is used much as anywhere else for lighting, power and domestic uses, there is little industry of any importance. The small plants find it cheaper to employ manual labour rather than electrical power, so that lighting remains the only available outlet for electricity. Traction is out of the question, as the narrowness of the streets in the smaller centres would not permit the installation of lines. As a result, in many small towns the plants are started up at nightfall and stopped at a definite hour of the evening or at dawn.

In the large centres development is more normal. This can be seen from the following figures.

Town.	No. of Plants.	Capacity in 000 kW, 1934.	New installations, 1935.	Production 1934 Million kWh.	Production 1935 Million kWh
Shanghai	7	247	40	1,031	993
Canton	1	24	30	89	87
Hangkow	4	23	—	59	65
Tientsin	5	37	—	59	59
Tsingtao	1	14	15	44	47
Peiping	3	24	15	48	45
Nanking	1	14	10	24	32
Hangchow ...	1	20	—	26	29

The possibilities of China in the direction of electrical development can thus be seen to be enormous. Outside of Shanghai, which stands in a unique position in the country, there is still an almost undeveloped industry. The activity of the National Construction Committee in encouraging the growth of larger plants with a capacity in the neighbourhood of 10,000 kW seems for the moment to be the best solution. However, until considerably more social and economic improvement takes place in the interior of the country so as to make it financially possible, the development of the hydraulic power resources will not be possible.

New Books

Diesel Engine Design. By H. F. P. Purday. Pp. 520; figs. 346. London: Constable & Co., Ltd. Price 24s. net.

Purday, from the early days of Diesel engine manufacture, has been recognised as a standard textbook on design, and this new edition (the fourth) will do much to enhance its reputation. It constitutes an almost entirely new work based upon the enormous strides made in Diesel engine practice during the past few years, and, in spite of deletions, contains no fewer than twenty-six chapters as against fifteen in the previous edition, while the whole of the text has been reset. While the book will appeal chiefly to the designer, it will also be of great value to the operating engineer as well as the student.

Recent technical developments of which the author has taken particular notice include the almost universal substitution of the airless system of fuel injection for the air-blast system, which was used on earlier designs, and the use of supercharging as a means of increasing the power output from a given size of cylinder, thus enabling it to deal efficiently with peak loads without substantial increase in capital cost.

Since many Diesel-driven generators are to-day being installed in large office buildings, stores, &c., consideration of methods of reducing the noise from moving parts might have been supplemented by attention to the possibility of deadening the effects of this noise by sound insulation in the foundations. The question of turning moment from the point of view of the paralleling of alternators is also worthy of fuller consideration. These are, however, but minor criticisms, and in so large and comprehensive a work what must be regarded as specialist problems are, of necessity, treated in a cursory manner. Indeed, the question may well be asked whether the term Diesel engine does not now cover so many widely differing types, ranging from high-speed aero engines to slow-speed units for driving electric generators, that its treatment as a single problem in design is becoming impossible. Perhaps the author himself recognises this, since he has brought to his aid the principle of similitude in an endeavour to show the relationship between the various widely differing types of engine. This is a very interesting innovation even if only because it suggests the conclusion that the large engine is over-complicated.

A valuable summary of the specialised literature available is given at the end of each chapter.

Commercial A.C. Measurements. By G. W. Stubbings. (Second edition.) Pp. 348; figs. 176. London: Chapman & Hall, Ltd. Price 15s. net.

In reviewing the first edition of this book, which appeared in 1930, we described it as essentially practical and of the utmost value to testing engineers of all grades in the factory and on the inspection staff. To-day the book still occupies the premier position it then made for itself in its own class. There is very little change in the new edition, but those who possess a copy of the original work may like to know of the principal alterations.

New geometrical theorems in connection with symmetrical studies and a note on the zero sequence component are now included (pp. 49-52). The expressions for total VA in an unbalanced three-phase circuit are extended and also applied on pp. 67 and 68 to the numerical example which follows (63, 64, 67 and 68). There are additions to the text in connection with copper-oxide rectifiers for use with a.c. ammeters and voltmeters and a new diagram of the rectifier VA characteristic is given (91-93). The treatment of the impedance of a.c. ammeters and voltmeters is extended (109-110), and includes a new diagram of connections for measuring the p.f. of instrument coils.

The B.S.I. grouping, rating and limits of errors of instrument transformers are brought up to date (145-147), while an account is now given of Wellings & Mayo's method of compensating current transformers under test for the phase error due to the magnetising component of the exciting current of the main current transformer (155-156). A comparison method of current-transformer testing (168-170) avoids the inaccuracy due to the impedance of an instrument measuring a difference current. A wattmeter method of checking polarities of bar-primary current transformers is given (186-187).

Chapter VIII is now entitled, more accurately, "The Measurement of Reactive Volt-amperes" (instead of reactive power), and an approximate way of measuring VAR by the crossed-phase method is described. To Chapter IX, on the measurement of kVA, are added brief notes on induction meters, with automatic phase compensations, and rectifier kVA meters. The treatment of phase-shifting transformers is extended (308-310), and a test circuit for checking frequency in which a galvanometer is used as a sensitive frequency indicator, is described and illustrated (319-320). The cathode-ray oscillograph receives some attention (326-328).

Shorter Notices

"Modern Foremanship," by T. H. Burnham (Sir Isaac Pitman and Sons, 7s. 6d.), deals with the necessary qualifications that a foreman or forewoman must possess in these days when a broader outlook and the acquisition of administrative, as distinct from technical, knowledge are becoming essential. The author shows how qualities of personality and leadership can be developed, and bases his work on a series of lectures delivered by himself to groups of foremen. Discussions which have followed his talks have also provided useful material.

"Electrical Inventions." By A. M. Low. (128 pp.; illus.) London: Thos. Nelson & Sons, Ltd. Price 2s. 6d. net. This is a brief popular account of the development and use of electricity in many spheres. The first five chapters deal respectively with lighting, heating, power, natural electricity (lightning) and the distribution of electricity. The rest of the book is devoted to more particular applications such as radio and television, and photo-electric cells, the final chapter covering a variety of small or unusual uses.

"Cars of To-day" (*The Times* Publishing Co., Ltd., 2s.) contains technical specifications of sixty-four cars and road tests carried out by *The Times* motoring correspondent during 1936.

"Electron Tubes in Industry," by K. Henney. (Second edition.) Pp. 539; figs. London: McGraw Hill Publishing Co. Price 30s.

"Elements of Electricity," by W. H. Timbie. (Third edition.) Pp. 569; figs. 470. London: Chapman & Hall, Ltd. Price 15s. (Answers to problems in this book, 1s. 9d.)

"The Transmission and Distribution of Electrical Energy," by H. Cotton. Pp. 452; figs. 274. London: English Universities Press, Ltd. Price 21s.

Business and Industrial Notes

The Week's News. Showrooms and Exhibitions. New Installations. Overseas Trade. Publicity Material. Trade Announcements. Prices of Materials. Liquidations and Bankruptcies.

Key Industry Duty

The Board of Trade has received an application under Section 5 (5) of the Finance Act, 1936, for a licence to import free of duty the following: An electro-mechanical gauging apparatus for indicating variations in thickness of non-magnetic materials, of the type known as the Schuster magnetic gauge, incorporating two balanced electric circuits, each circuit including an electro-magnet having an adjustable air gap between it and its armature. Any representations that a similar instrument is made, or is likely to be made within a reasonable time, in the United Kingdom or elsewhere in the Dominions, should be addressed to the principal assistant secretary, Industries and Manufactures Department, Board of Trade, Great George Street, London, S.W.1, within one month from March 24th.

Electric Wire Production in Palestine

The entire demands of Palestine electrification are expected to be met by the establishment of the Electric Wire Co., of Palestine, Ltd., whose machinery has been tested during the last few weeks. These will be the first wires ever made in the country, which has been importing them at the rate of

£45,000 per year. Even the cotton yarn for insulating the wires is of local manufacture. With a fully paid-up capital of £25,000 (one of the main shareholders being Palestine Electric Corporation), the company is benefiting by the cessation of wire exports from Germany and other countries which need the material for internal purposes. Mr. Majerczik is the chairman of the company, and Dr. Broide and Dipl. Eng. Rosenberg are the managing directors. The new factory is situated on the Haifa Bay coast and is in a new industrial zone.

"Northmet" Coronation Exhibition

An exhibition similar to that held on the occasion of King George V's Jubilee in 1935 has been arranged in the demonstration theatre of the "Northmet" showrooms at Wood Green. The purpose of the display is to gather together a selection of devices produced by manufacturers so that intending purchasers can see them all at one time. Altogether there are about eighty pieces on view, and so far the results have been very gratifying. Manufacturers represented include: Falk Stadelmann & Co., Ltd.; Crompton Parkinson, Ltd.; Edison Swan Electric Co., Ltd.; Siemens Electric Lamps and Supplies, Ltd.; General Electric Co., Ltd.; Philips Lamps, Ltd.; British Thomson-Houston Co., Ltd.; Burt Bros. (Bow), Ltd.; Wright Display, Ltd.; Beeantee Illuminations, Ltd.; Gemosigns, Ltd.; Franco Signs, Ltd.; and Walter Ellerby, Ltd. A window display for use at each of the company's showrooms has been arranged by Bryant & Knowlson, Ltd. The exhibition is to continue until April 10th.

A section of the "Northmet" Coronation exhibition, and (above) the special window display

Valuation of Hydro-electric Works

The Valuation Appeal Court, Edinburgh, on March 25th, gave judgments in cross-appeals by the British Aluminium Co., Ltd., and the Assessors for Inverness-shire and Argyll arising out of a revaluation of industrial concerns in both counties, which the Assessors have been carrying through during the last two years. The Court fixed the gross annual values as follows: Foyers Works, £4,736; Kinlochleven Works in Inverness-shire, part of Blackwater Dam, £3,750; Loch Eilde Mhor pipe conduit, £2,057; Kinlochleven Works in Argyll, £26,673.

Lord Fleming said that both Assessors were demanding large increases on the figures which had hitherto stood in the Roll. The only definite data available for fixing the valuation of these undertakings was the original cost of construction, and it was obvious that that cost might have little relation to their present value. The Assessors claimed that their value must be taken to be at least 25 per cent. above the cost of construction. His Lordship was quite unable to agree with this, and his conclusion was that the Assessors had not shown that the works were of greater value to-day than their original cost of construction. The more correct method, his Lordship thought, was to fix the capital value after making due allowance for depreciation and obsolescence. If such allowance were made, there appeared to be no sufficient grounds for altering the percentage rates adopted by the Assessors, subject to one exception. It was suggested on behalf of the company that, with regard to the civil engineering works, the rate should be one per cent. Such a rate was quite indefensible. On the other hand, the Assessor for Argyll had asked a higher rate than the Inverness-shire Assessor, namely, 7 per cent., as against 5 per cent. His Lordship preferred the lower figure. The Argyll Committee, dealing with the Argyll part of the Kinlochleven undertaking, had allowed an overhead deduction of 25 per cent. in respect of depreciation and obsolescence. That deduction was reasonable and should be applied to the whole of the Kinlochleven undertaking. The considerations which affected the Foyers undertaking were similar to those applicable to Kinlochleven, subject, however, to the important distinction that they were much older. He suggested that as regarded these works the overhead deduction of 33⅓ per cent. should be applied. Lords Pitman and Robertson reached a similar conclusion.

Whitley Council Secretaries' Meeting

The Employers' Secretaries to the District Boards and Councils for the Electricity Supply Industry held their second annual meeting in Manchester on March 24th, when they discussed matters relating to the administration of the Whitley organisation. Mr. G. G. Heathcock, secretary to the No. 5 District Council and Board (Birmingham, &c., Area) was appointed chairman for the ensuing year. After the meeting the secretaries were entertained to lunch by Sir Thomas Higham, chairman of the No. 3 District Employers, who was accompanied by Alderman W. Walker, chairman of the National Employers' Organisation, and Mr. C. D. Taite.

United States Lamp Imports

Notwithstanding the development of the home electrical industry the United States is still an important market for imported electric lamps, 142,564,938 (valued at £217,801) being imported during 1936, as compared with 104,446,510 (worth £196,416) in the preceding year.

Electric Steel Furnaces in Rumania

Plant for the electric production of steel has recently been installed at the works of the Concordia Petroleum Co. at Ploesti, Rumania. The installation comprises two furnaces, one of a capacity of 3 tons and the other of 10 cwt. Both are of the tipping variety and are basic lined; the control is on the Secomet-Vastel system, the feature being that only one set of power-supply adjustment gear is provided for the two furnaces, it being switched over to one or the other when

necessary, as only one furnace is in operation at a time. The power is supplied at 25 kV. to a 300 kVA transformer with tappings for 90, 106, 125 and 130-V.

Alderley Edge and Wilmslow Exhibition

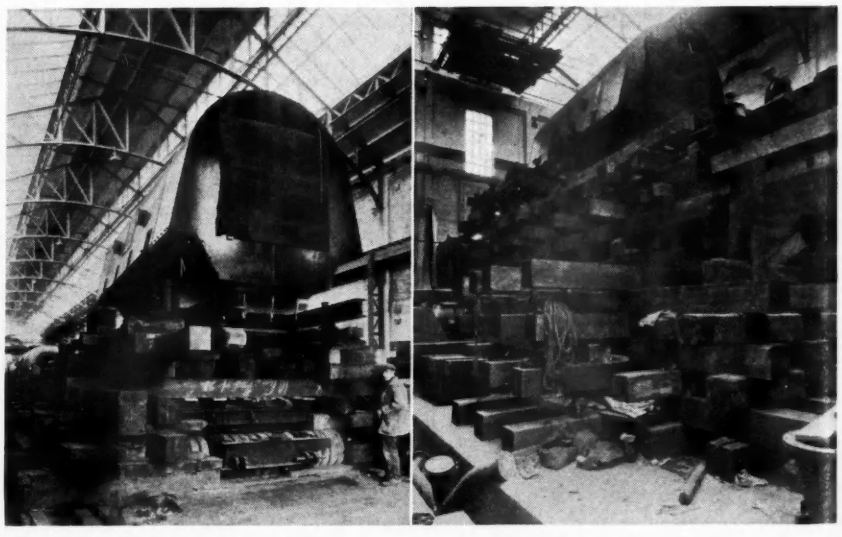
The accompanying illustration shows the display of the Alderley Edge and Wilmslow Electricity Board at the recent local Modern Homes Exhibition In sending us the photograph, Mr. C. Cameron Kirby, the engineer and manager, states that the Board is already beginning to feel the results of this form of publicity. The "all-in" tariff running charge was reduced last spring to ½d. per kWh for the two summer quarters,

The display of the Alderley Edge and Wilmslow Electricity Board at the local Modern Homes Exhibition

as a result the energy sold on this rate for the two summer quarters of 1936 shows an increase of 50 per cent. on that of the previous year. The Board has now installed nearly 1,000 cookers and over 300 water-heaters. As the total number of consumers is less than 4,000, Mr. Kirby considers that the progress has been satisfactory.

Handling an 82-ton Stator

Workmen of Norman E. Box and Pickfords, Ltd., recently erected an 82-ton stator of a 37,500-kVA 33kV generator in the Brimsdown power station of the North Metropolitan Electric Power Supply Co. The generator, together with its turbine, had been built by the Metropolitan-Vickers Electrical Co., and its transport from Trafford Park, Manchester, to Brimsdown involved considerable initial difficulties. At the works the stator was lifted by two 50-ton cranes and loaded upon a special low truck of the L. & N.E.R. Even with the low carrying level the stator had to be offset sideways to clear the overhead loading gauges, and the journey had to be made under special week-end arrangements to avoid interference with traffic. At the siding at Brimsdown the stator was transferred by means of jacks to a 100-ton road wagon with four axles and thirty-two rubber-tyred wheels for a 400-yd. journey to its site in the power station. Here in successive stages the stator was raised by four hydraulic jacks and packed underneath with huge baulks of timber until the requisite lift of about 18 ft. to its mounting level had been achieved.



Left: An intermediate stage in the raising of the 82-ton stator; the road wagon can be seen below the growing structure. Right: The tower of packing baulks needed to elevate the stator to the required height

The "Met-Vick" Calendar

The "girl" calendar for 1937-38, which we have just received from the Metropolitan-Vickers Electrical Co., Ltd., again favours the fair type of English beauty, and continues the high standard of this series.

Social Events

On March 20th Rawlings Bros., Ltd., entertained their employés and their wives to a social evening and entertainment at Derry & Toms. Mr. W. R. Rawlings, who presided over a gathering of 700, was accompanied by Mrs. Rawlings and supported by Mr. J. Rawlings, his brother, and Mrs. J. Rawlings, Mr. and Mrs. W. J. Rawlings (son and daughter-in-law), Mr. Tweedie Smith, Mrs. Tweedie Smith, and Mr. T. S. Rowden. The evening began with the first part of a concert given by many well-known artists. Following a buffet supper, Mr. W. R. Rawlings made a very brief speech, in which he said that to-day the staff totalled 400. He thanked the committee for the way they had organised the evening and said that the efforts of the programme sellers had resulted in a sum of £10 being collected for the Benevolent Fund, which Mr. J. Rawlings promised to supplement by a similar amount. On behalf of the staff and all present, Mr. C. J. Kelly returned thanks to the directors for the evening's entertainment. Presentations were made to Mr. and Mrs. W. J. Rawlings, who were responsible for arranging the concert.

America's Domestic Appliance Trade

Recent official trade returns show that there was a further marked improvement last year in the overseas demand for American domestic electrical appliances, the gross value of the shipments from the United States amounting to £3,018,472, as compared with £2,391,176 in the preceding twelve months. The accompanying table gives the details of the shipments during the past two years :—

	1935.		1936.	
	No.	£	No.	£
Fans	59,745	71,774	106,143	109,649
Household refrigerators ...	119,845	1,870,848	106,394	2,348,027
Washing machines	12,036	110,760	26,649	213,283
Irons	115,414	35,831	140,041	44,926
Cooking ranges	4,143	53,810	6,297	73,022
Domestic vacuum cleaners ...	21,376	66,761	30,289	101,753
Other domestic electrical appliances	222,103	181,392	226,796	127,812
Totals		£2,391,176		£3,018,472

As will be seen, each of the items with one exception shared in the increase. The exception is that of unclassified material of which, as regards quantity, more was shipped last year, with, however, a decline in the gross value.

E.D.A. (Scottish Area) Luncheon

The principal speaker at the recent annual luncheon in Glasgow of the British Electrical Development Association (Scotish Area) was Sir David Allan Hay, Commissioner for Special Areas in Scoland. Electricity in this country, he said, was mostly the result of energy derived from coal. Unless they could get coal as cheaply as possible, their electricity would be dearer. Coal had been increasingly and more economically produced by means of electrical cutters and conveyors, and, in fact, in Lanarkshire, had it not been for electrical developments, the coal industry there would have faced a very black outlook. Unless the most use was made of coal, and unless the gases that were derived from coal could be got rid of profitably to the community, they were not going to maintain their pig iron and their steel industries. If they could not maintain these two industries, then they would not maintain all the other industries dependent upon them. Sir David, who was proposing the toast of "The Association," said that in Great Britain in 1929 there were only 750,000 domestic users of electricity. Now there were about 7,000,000 users, with 500,000 domestic users being connected up each year. That was an indication of the striking advance in the use of electricity. They had passed through a very great depression, yet that advance had taken place. With regard to the areas immediately around Glasgow, which were called Special Areas, he looked upon these, so far as electricity was concerned, as offering the highest possible attraction to industry to come to Scotland.

Mr. A. C. Cramb, director of the British Electrical Development Association, in reply, said there were seven and a half million consumers in this country at the present time. There were still left four million householders who had yet

to enjoy the benefits of electricity. He urged the greater adoption of electric transport. We went on increasing the imports of oil to run our transport, while we had coal for electricity available in our own coalfields and men standing idle. "The Scottish Area Committee" was proposed by ex-Provost A. G. Logan, Falkirk, and the chairman, Major H. Bell, replied.

A Refrigerator Factory Extension

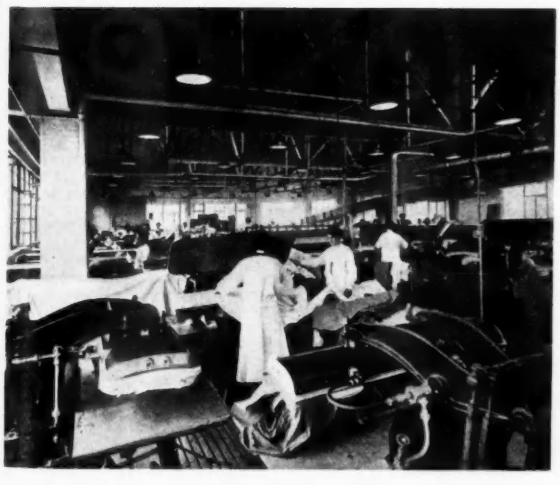
To permit of the complete centralisation of the administrative staff, Marco Refrigerators, Ltd., has erected a large new office block adjacent to its factory in Rowan Road, Streatham Vale, London, S.W.16. A well-equipped showroom in the new building provides facilities for the display of representative examples of the company's domestic and commercial equipment including ice-cream making plant and a full-sized milk-bar.

Electric Cooking Progress in France

The Bulletin of the Association des Applications de l'Electricité, of Paris, has just issued its annual report on the progress of the adoption of electric cooking in France and North Africa. It shows that at the end of September last the number of electric cooking appliances in use amounted to about 160,000, as compared with 118,000 at the end of the preceding year and 16,000 at the end of September, 1931. Thus the increase for the past twelve months is equal to 35½ per cent., while during the past six years the number has increased tenfold. The report shows that in France and North Africa there are now 376 blocks of flats with 7,351 rooms in which the cooking is entirely effected by electricity, while the number of restaurants fitted with electric cooking appliances has advanced during the past twelve-months from 422 to 1,092, with an aggregate load of 11,061 kW, the progress being due chiefly to the large number of small restaurants and country inns that have adopted electric cooking.

An Industrial Lighting Installation

Expansion of business by the Aerated Bread Co., Ltd., has necessitated considerable reconstruction work at the company's headquarters at Camden Town, London. The first section has recently been completed, and it affords an interesting example of an efficient industrial lighting installation. The completed section includes a modern laundry which serves the company's branches over a wide area. Here the lighting

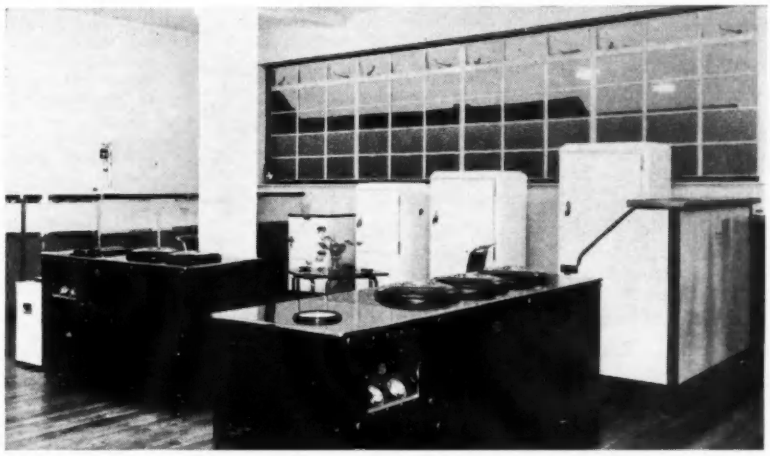


The laundry of the A.B.C. at Camden Town illuminated by G.E.C. reflectors

is effected by a number of G.E.C. industrial lighting reflectors, over four hundred of which were supplied for the complete installation. These reflectors are also used in the workshops, garage and equipment store, supplemented by a number of "Coolicon" reflectors and bulkhead fittings. The whole of the lighting installation of these new premises was carried out by G. E. Taylor & Co., Ltd., to the requirements of the consulting engineers, C. W. Glover and Partners. Other G.E.C. equipment supplied for this installation includes lighting fuseboards, switchgear, conduit and conduit fittings.

"B.B.C. Annual, 1937"

Radio listeners in the home counties who are thinking of becoming television viewers should consult the field-strength chart of the Alexandra Palace transmitter given in "B.B.C. Annual, 1937." This shows, by means of contour lines, the strength of signals from the London television station at any point within about thirty miles of London. For taking these measurements apparatus was accommodated in a specially constructed van with bodywork which was practically free from metal parts, and after suppressors had been fitted to the ignition system it was practicable to record even low field-strengths when the van was in motion. Some idea of the development of the broadcasting service in the ten years just ended may be obtained from a comparison of items in the revenue accounts for 1927 and 1936 included in a chapter on finance. Programme expenditure of £487,728 in 1927 com-



[Elec. Rev. photo.

A corner of the showroom at the new offices of Marco Refrigerators, Ltd., in Rowan Road, Streatham Vale

pares with £1,339,202 in 1936, and engineering costs of £131,037 with £490,289. A type of studio new to this country in which the half accommodating the orchestra is free of acoustical treatment is referred to in an article on studio design. The chief events of 1936 are reviewed in general notes and chapters dealing with various aspects of the service, from which the trend of future development in broadcast music, drama, variety, schools, talks, outside broadcasting and other activities may be gauged. A chart discloses the allocation of programme time. The work of three mobile recording units used for securing and adapting material for programme purposes is explained and illustrated. Discs obtained by the mobile units are "edited" on a special bank of turntables and a control panel by means of which single sentences or single words can be extracted. Consisting of 176 pages, profusely illustrated, the Annual is useful in many ways as a book of reference. Beside lists of advisory councils and committees of the B.B.C., and rules for S.O.S. messages, it contains particulars of arrangements for visits to London and provincial studios, details of weather forecasts and the time signal service. Its price is 2s. 6d., or 3s. by post, and it can be obtained from the B.B.C. Publications Department, 35, High Street, Marylebone, London, W.1, or to the B.B.C.'s Regional offices.

A Radio Annual

The 1937 "Broadcaster Radio and Gramophone Trade Annual," which has just been published (*Wireless Retailer and Broadcaster*, 5s. post free), is in similar form to previous editions. It is divided into four main sections dealing with trade organisation and progress, technical matters, commercial and legal information, and a directory. Some of the features are an aerial-to-picture explanation of television, a map of the television reception area, a service section and radio encyclopædia, a directory of radio manufacturers and wholesalers, a "Who's Who" in radio, and a battery and mains set market review. The technical information includes "first aid" data for sixty best-selling sets; characteristics of 1,000 valves; and supply voltages of 7,000 towns. Special features deal with h.p. and renting agreements, and articles on simple service costing.

A Southport Electricity Campaign

Electrical contractors of Southport recently conferred with the local Electricity Committee concerning the forthcoming Spring publicity campaign to be undertaken by the Electricity Department. Councillor Sherrington (vice-chairman of the Electricity Committee) pointed out that it was proposed to start the campaign by holding demonstrations extending over a period of two weeks. For the first week demonstrations and film shows would be held in the outlying districts of the borough. Suitable electrical films would be shown at local cinemas. There would also be demonstrations of electrical apparatus at the Plaza. During the second week of the campaign it had been decided to hold demonstrations and exhibitions at the Electricity Department's showrooms in Lord Street. Pointing out that the use of water-heaters should be extended as much as possible, he stated that this type of apparatus was considered a great asset to the undertaking because of the extended use in the summer time, when the loads on the undertaking were not so heavy as in winter.

Manchester Building Trades Exhibition

Sir Alexander Gibb is to open the Building Trades Exhibition which is being held at the City Hall, Manchester, from April 6th to 17th. The Lord Mayor of Manchester, Alderman J. Toole, will take the chair. This exhibition is the fifteenth of its kind and will be fully representative of all sides of the building and allied trades. An architectural competition, which has been organised in conjunction with the Manchester Society of Architects, has attracted large numbers of entries. Special facilities have again been arranged with the railway companies, which entitle the holder to travel at single fare for the return journey from all towns within an 80-mile radius of Manchester.

For Sale

Wallasey Corporation invites offers for the purchase and removal of scrap metals.

West Central Merchandise Mart will sell by auction on April 14th and 15th the stock of an electrical wholesaler.

(See our classified advertisements.)

Trade Announcements

The Universal Lamp Co. has removed to 23, Rochdale Road, Manchester, 4.

The Nevelin Electric Co., Ltd., has removed to Purley Way, Croydon (telephone: Croydon 2260).

The Progress Electrical Co. has been appointed sole selling agent for Great Britain for the lighting and power cables and flexibles manufactured by Dr. Cassiner A.G. Charlottenburg, Berlin.

The Model Railway Exhibition

Even though the steam locomotive still appears to hold the pride of place in the affections of the model railway engineer, examples of whose skill are to be seen this week at the Model Railway Exhibition at the Central Hall, Westminster, electricity is now used almost without exception to provide the necessary motive power. The various railway electrification schemes being carried out in this country are also being reflected in the exhibits, one of the most striking of which is a large scale (10 m.m. to 1 ft.) three-coach Southern Railway electric train, complete with station, points, signals, etc. An overhead conductor railway system, a tube station, and cable trucks with drum are other especially interesting items. The provision of extra space at this year's display has resulted in much improved facilities for the presentation of exhibits, in particular those of the members of the Model Railway Club and also those separate sections devoted to the various British railway systems. Among the trade exhibitors are:—Walkers and Holtzapffel (Retail), Ltd.; Mills Bros. (Model Engineers), Ltd.; Bassett Lowke, Ltd.; Windsor Model Co., City Model Co., Hamblings; Buck & Ryan; and Leeds Model Co., Ltd.

Prices of Materials

Messrs. Henry Gardner & Co. report, March 31st.: Copper bars (best selected), sheet and rod, £108, £1 inc. English pig lead, £33 15s., 5s. dec. Spelter, £33 15s., 12s. 6d. inc. English block tin, £294, £3 10s. dec.

Messrs. Frederick Smith & Co. report, March 31st: Electrolytic copper bars, £80, £3 inc. Ditto, ditto, wire rods, £85, £11 inc. Ditto, ditto, h.c. wire, 11½d., ⅜d. inc. Silicium bronze wire, 1s. 0⅜d., ⅜d. inc.

Messrs. Edward Till & Co. report, March 21st: No change in the price of India rubber, Para fine.

New Catalogues and Lists

Sun Electrical Co., Ltd., 118, Charing Cross Road, London, W.C.2.—A catalogue of Coronation devices and illumination materials.

Kandem Motors, Ltd., 769, Fulham Road, London, S.W.6.—A price-list of a.c. induction motors and a leaflet describing high torque squirrel-cage motors.

Birmingham Electric Furnaces, Ltd., Birlec Works, Tyburn Road, Erdington, Birmingham.—A leaflet dealing with salt baths for aluminium alloys.

M.K. Electric, Ltd., Wakefield Street, Edmonton, N.18.—Leaflets relating to sockets with dust-proof covers, dual sockets, twin adaptors with screened sockets, and interlocked switch sockets.

G. Cohen, Sons & Co., Ltd., 600, Commercial Road, London, E.14.—A catalogue of hydraulic plant.

A.E.W., Ltd., Imperial Works, High Street, Edgware.—Details of a new type of electric furnace.

Smith's English Clocks, Ltd., Cricklewood Works, London, N.W.2.—A 52-page illustrated art catalogue of electric clocks.

Bankruptcy Proceedings

N. Hall, trading as Hall & Co., 66, Margaret Street, Ashton-under-Lyne, and as Horners, 278, Stamford Street, Ashton-under-Lyne, wholesale and retail radio dealer.—The first meeting of creditors herein was held at the Official Receiver's Offices, 22, Byrom Street, Manchester, recently. It was reported that the unsecured creditors' claims amounted to £2,128, whilst the assets were estimated to produce £1,195, but it was considered doubtful whether the various items included in those items would realise the amounts set down. The creditors resolved to appoint Mr. F. E. Bendall, accountant, of Manchester, as trustee of the estate, with a committee of inspection consisting of the representatives of the Chorlton Metal Co., Ltd., the General Electric Co., Ltd., and Mr. A. T. Eaves, representing creditors.

H. A. Simpson and **E. Dyson,** trading together in co-partnership as "Simpsons," 18, Eastbank Street, Southport, radio and electrical engineers.—The public examination of these debtors was further adjourned at the Court House, Liverpool, recently, as the accounts lodged by them had not been checked by the Official Receiver.

R. Brightwell, electrical contractor, 107, Queen's Road, W.2.—Receiving order March 23rd on a creditor's petition. First meeting April 8th and public examination May 5th, both at Bankruptcy Buildings, Carey Street, W.C.

J. H. Maddox (Imperial Electrical Supplies Co.), dealer in electrical accessories, lately trading at 14, Whitecross Place, Finsbury Pavement, E.C.—Discharge suspended for six months until August 26th.

J. J. Jennison, electrical contractor, Y.M.C.A., Dale End, Birmingham, formerly carrying on businesss at Excise Chambers, Pelham Street, Nottingham. Trustee, Mr. A. Boaler, Bromley House, Angel Row, Nottingham, appointed March 20th.

E. A. Freeman, wireless dealer, 260, High Street, Ponders End, Middlesex.—Trustee, Mr. J. L. Poland, 29, Russell Square, W.C., Official Receiver, released March 15th.

J. W. Froggatt and **G. T. Shackleford** (F. & S. Radio), electricians, The Coneries, Loughborough.—Last day for receiving proofs for dividend April 10th. Trustee, Mr. E. Barlow, 1, Beveridge Street, Leicester, Official Receiver.

Company Liquidations

Wallasey Electrical Equipment Co., Ltd.—Meetings April 21st at 35, Exchange Chambers, 2, Bixteth Street, Liverpool, to receive an account of the winding-up by the liquidator, Mr. P. S. Booth.

Mitchell Electric Co., Ltd.—Meeting April 30th at 12, Cherry Street, Birmingham, to receive an account of the winding-up by the liquidator, Mr. W. L. Hand.

Electric Supply Co., of Victoria, Ltd.—Meeting April 30th at 5, Fenwick Street, Liverpool, to receive an account of the winding-up by the liquidators, Messrs. G. M. West and A. Roger.

Southport Northern Wireless Supplies, Ltd.—Meeting April 24th at 39, Fishergate, Preston, to receive an account of the winding-up by the liquidator, Mr. W. E. Hopkins.

Private Arrangements

Amalgamated Electrical & Lighting Equipment Co., Ltd., 201-211, Bishopsgate, London, E.C.2.—An informal meeting of the creditors in this matter was held on March 27th at the First Avenue Hotel, London, W.C., when Mr. J. O'Reilly, a director of the company, presided. He informed the creditors that the shareholders had previously discussed the position at some length, and, having regard to the fact that certain proxies had been sent in for the company to be administered in voluntary liquidation, a resolution had been passed to that effect, and a partner in the firm of E. C. Baldwin & Son, of Park Lane, London, W., had been nominated liquidator. Mr. O'Reilly pointed out, however, that certain shareholders had intimated that they were not prepared to accept the voluntary liquidation proceedings, but would proceed, therefore, by way of compulsory liquidation, and they intended to instruct a solicitor to present a petition to the Court for the compulsory liquidation of the company as soon as possible. Mr. O'Reilly said that the shareholders thought the company was going to exercise its legitimate purpose for good trading. About November or December last it started a trade which had been unfortunate. It should have been promising, but owing to an unsavoury case which had been reported extensively in the papers recently the company found itself in unfortunate circumstances and unable to go on. Liabilities could not be met and shareholders had been deceived like the creditors. To make matters worse the chairman, Lord Naas, resigned at a very inopportune time. Certain individuals unknown to shareholders—outside brokers they had never seen—got hold of their shares. No financial statement was submitted, but the secretary of the company said the liabilities were approximately £2,100, and the assets consisted of £130 of book debts and between £10 and £15 of stock, but there was £45 owing for rent. The nominal capital of the company was £100,000, of which £64,000 had been issued. The company acquired the rights in certain patents, and the patentee now proposed to take proceedings against the directors of the company. Mr. Houston (representing creditors) said he understood that certain shareholders desired to present a petition for the compulsory winding-up of the company, and that they proposed to do so through a certain gentleman. Mr. Houston suggested that the meeting should refuse to recognise the voluntary liquidation. Probably the shareholders who desired compulsory liquidation had more information with regard to the case than had the creditors. He proposed that the voluntary liquidation of the company be not confirmed. That proposition was seconded and carried.

H. C. Bishop, trading as "Bishops," 174, Bitterne Road, Southampton, wireless dealer, &c.—At the meeting of the creditors of the above the statement of affairs showed liabilities of £410, of which £257 was due to the trade, and the balance of £153 to cash creditors. The net assets were £177, leaving a deficiency of £233. Debtor attributed his position to lack of turnover. He was now in employment and he was willing to set aside £3 a month out of his earnings for the benefit of his creditors. It was decided that the estate should be dealt with under a deed of assignment with Mr. W. C. Black as trustee.

W. F. Powdrell, 269, Hessle Road, Hull, wireless dealer, &c.—A meeting of the creditors of the above was held recently at Hull, when the statement of affairs disclosed liabilities of £633, of which £409 was due to the trade, and the balance of £224 to cash creditors. The net assets were £189, leaving a deficiency of £444. The creditors resolved to confirm the deed of assignment already executed to Mr. P. H. Lambert, of Parliament House, Parliament Street, Hull. A committee was also appointed.

T. J. Stephens, wireless dealer, trading as T. J. Stephens & Son, 97, Islingword Road, Brighton.—A meeting of the creditors of the above was held on March 24th at the offices of Mr. A. E. Orbell, accountant and auditor, 6-7, Old Stein, Brighton. The statement of affairs showed liabilities of £210, all due to the trade. The net assets were £110, leaving a deficiency of £100. It was resolved that the debtor should give a letter of authority to Mr. Orbell to realise the assets and distribute the proceeds *pro rata* amongst the creditors in settlement of their claims.

Electricity Supply

Lighting, Domestic, Power

Aberayron (Cardiganshire).—OVERHEAD LINES.—The Urban District Council is to support the application of the West Cambrian Power Co. to the Ministry of Transport for permission to erect overhead lines in the Council's area.

Annfield Plain.—CHEAPER ELECTRICITY.—The Urban District Council has agreed to the reduction of electricity charges as follows: Ordinary consumers, an all-round reduction of 1d. per kWh for lighting; domestic consumers, standing charge reduced by 1s. per month; prepayment consumers, discount increased by 10 per cent.

Argentina.—ELECTRICITY PRODUCTION.—The Compania Hispano-Americana de Electricidad, S.A., reports an increase in the quantity of electricity produced. For 1936 the total was 1,177,965,000 kWh, against 1,089,825,000 kWh in 1935.

Barnes (Surrey).—CHANGE-OVER.—The Town Council has applied to the Electricity Commissioners for sanction to change over the supply in the Kew area to a.c. at an estimated cost of £3,000, including the erection of a sub-station with equipment, &c.

Bexhill-on-Sea.—LOAN.—The Town Council is to make an application for sanction to a loan of £8,336 for various works necessary to maintain existing supplies and to meet anticipated demands, including the provision of sub-stations on the Whitehouse Farm estate and at Broadoak Farm for the Whitehill district and a number of feeder extensions and replacement of mains.

Blackburn.—LOAN.—Sanction is being sought by the Corporation to borrow £20,000 for electrical appliances. Application is also being made for sanction to borrow £5,800, the cost of an extension of the Darwen transmission line. Tenders will be invited for the supply of the necessary switchgear and equipment. A loan of £8,418 is also sought for reinforcement of the transmission line between Whitebirk generating station and Jubilee Street distributing station.

Bridlington.—TWO-PART TARIFF.—An optional two-part tariff has been instituted by the Town Council in respect of private dwelling houses, hotels, and offices where a separate assessment for rating purposes is in force as an alternative to the present flat-rate charges. It comprises an annual fixed charge of 15 per cent. on the current rateable value of the premises, plus meter rent and a charge of ½d. per kWh for all electricity consumed.

Brighton.—ALL-ELECTRIC HOUSES.—In order to meet the demand for supplies to 142 all-electric houses and shops in the northern section of the Saltdean estate the Electricity Committee proposes to erect a sub-station in Westfield Avenue, the estimated cost being £3,008.

TRANSFORMERS.—The existing 500-kVA transformers at the Hampton Place sub-station are to be replaced by two of 1,000 kVA capacity each, at an estimated cost of £1,600.

SUB-STATION.—The development of the West Blatchington estate, Hove, has necessitated the erection of a sub-station at the junction of Holmes Avenue and Nevill Avenue by the Electricity Committee at a cost of £3,414.

Burma.—CLAY QUARRY LIGHTING.—The illumination of a clay quarry during the work of excavation is another example

Quarry lighting in Burma

of the successful uses to which electric-discharge lamps have been put under unusual conditions. The clay quarry in question is in Burma and is being worked by the Indo-Burma Petroleum Co., Ltd. The clay excavated is used for facing a river retaining wall. It is built up about 4 ft. thick on a bank of sand to serve as a foundation to a final brick or stone facing. Five 150-W "Osira" lamps in parabolic reflectors mounted 30 ft. high and 150 ft. apart are installed so that work on the clay bank can proceed during night time. Similar lamps are used for lighting the railway from the quarry to the base of the river wall, and for lighting the working area by the river edge.

Cheshunt (Hertfordshire).—ELECTRICITY FOR COUNCIL HOUSES.—Electricity is to be installed in the Council houses, and the Urban District Council has decided that 2d. per week shall be charged for the service to non-parlour type houses and 3d. per week to the parlour type.

Chester.—METERS.—Sanction to borrow £15,000 for meters is being sought by the Electricity Committee.

DEARER ELECTRICITY.—The adoption of a new electricity tariff which will mean an increase of approximately 10 per cent. is recommended by the Electricity Committee. This arises from increased expenditure in (a) the cost of materials used for revenue and capital works, (b) the cost of fuel used at Queen's Ferry power station and in respect of electricity supplied by the Central Electricity Board, and (c) wages and rates. In the city the tariff will be as follows: Lighting for general use, first 1,000 kWh per quarter 4.4d. per kWh, scaling down to 2.4d. per kWh above 10,000 kWh per quarter; business premises, a two-part tariff for lighting of £4 per kW of maximum demand for each quarter and a kWh charge of 0.5d.

ELECTRIC LIGHTING.—The Electricity Committee is to provide electric street lighting in the areas added to the city at a cost of £1,240.

Finchley.—LOANS.—Sanction has been obtained to borrow £3,000 for mains, £8,000 for apparatus, and £2,000 for wiring, and the Electricity Committee is to seek permission to borrow £40,000 for mains and services.

Greenock.—STREET LIGHTING.—A new lighting scheme for certain bus routes is under consideration by the Corporation.

Ilford.—WIRING INSTALLATIONS.—Sanction has been obtained by the Electricity Committee to borrow £10,000 for wiring installations.

Isle of Thanet.—REDUCED CHARGES.—The Isle of Thanet Electric Supply Co., Ltd., announces that electric cookers and water-heaters are now available on hire with specially reduced rates for supply.

London.—FULHAM.—It is proposed to consent to an application of the owners of 155 flats comprising West Kensington Court for a kW demand tariff. A similar tariff has been in force at Rivermead Court since 1930. The proposed terms are £9 5s. per kW per annum, with a running charge of ½d. per kWh.

Negotiations have been concluded between the borough electrical engineer and the Samuel Lewis Trust with a view to the provision of electricity supplies to 198 flats in Lisgar Terrace. Permission has been obtained for the Electricity Department to canvass all the tenants for the installation of cookers, and from past experience the borough electrical engineer anticipates that within two years 50 per cent. of the flats will adopt electric cooking.

BATTERSEA.—The Electricity Committee has arranged for the provision of 101 electricity services at a cost of £738.

The Works Committee is to improve the lighting in St. James Road. Fifteen tall electric lighting standards are to replace the existing seventeen small standards.

Proposed extensions and replacement of mains involve an expenditure of £2,750.

HAMMERSMITH.—Estimated expenditure by the Electricity Committee during the year ending March 31st, 1938, comprises the following:—Sub-station sites (£3,000), buildings (£6,500), switchgear (£11,000), and transformers (£10,500); generating station switchgear (£11,000), cables and services (£25,000), meters (£7,000), hired installations (£3,000), and hired apparatus (£8,000).

An application has been received for a supply of electricity to six blocks (comprising 54 flats) proposed to be erected on the north side of Hamlet Gardens. Following negotiations the owners of the flats are prepared to wire them for refrigerators, electric cookers, electric fires and panel heaters, providing a contribution is made towards the cost of the requisite rising and sub-mains on the premises. It is recommended that the Council should contribute £100.

The erection of the Council's 269 tenements at Emlyn Gardens has now been commenced. It is proposed that a high-voltage main shall be laid from the Wendell Road sub-station to two sub-stations to be erected on the west side of the site, and to lay low voltage cables to the various service positions. The cost of affording the supply is estimated at £2,320. Provision will be made in each flat for electric cooking, heating and lighting supplies, and, in these circumstances, it is suggested that the Council should make a contribution of £625 towards the cost of the installation of the necessary rising and sub-mains for these services.

An application has been received for a supply of electricity to a new depôt and offices proposed to be erected by Mills Scaffold Co., Ltd., on the south side of Trussley Road. The consumers have agreed to provide a sub-station building free of cost to the Council, to lease it to the Council at a nominal rental, and to allow it to be used for general distribution purposes.

The electrical installation at the Central Library is some 30 years old, and re-wiring and the installation of an up-to-date

system of lighting are contemplated. The chief electrical engineer recommends a reduction in the number of lighting points, with a general increase in the wattage of the lamps. The fittings, except where, owing to the low ceiling, it will be necessary to use batten type holders and opal shades, will be of the spherical opal type, suspended on tubes from ball and socket covers. In the Lending Department, it will be necessary to use special lantern-type fittings under the dome on account of the little reflection from the glass roof.

The Electricity Committee proposes that the rebate on electricity charges shall be increased from 12½ to 15 per cent.

St. Pancras.—For some time past the work of improving the lighting of the main streets of the borough has been in progress, electric-discharge lamps being used extensively. The most recent improvement is in Euston Road, between King's Cross and Gordon Street. It is thought that this is in advance of anything previously carried out in the borough, and that public attention should be drawn to it. Accordingly, it has been arranged that the installation shall be officially inaugurated by the Mayor to-day (Friday).

The Electricity and Public Lighting Committee proposes to construct and equip sub-stations at a total estimated cost of £14,273. One is required to meet a substantial demand for electricity in a new building in James Street. Another, on the Council's Brookfield estate, is made necessary by the proposed change from d.c. to a.c. in the northern area of the borough. In view of the anticipated demand for electricity in the High Street area, caused by the erection by the Council of working-class dwellings and the extension of a.c. supplies in the neighbourhood generally, it is necessary that the High Street chamber, which incidentally housed the undertaking's first sub-station, should again be utilised as a sub-station. Owing to the increasing demands for electricity in the Gray's Inn Road area it is necessary to increase the plant capacity of the Wells Street sub-station. This sub-station, like that at the Cobden Statue, is an underground one, and was provided in the very early days for balancing purposes. It remained out of commission for many years, and was re-equipped as a sub-station a few years ago, when a.c. supplies were introduced into the immediate neighbourhood. To meet the demand for electricity in the neighbourhood served by the Grafton Road sub-station it is necessary to provide additional equipment at this sub-station so as to afford a.c. supplies in the area. As it is not possible to house the additional equipment in the existing rotary sub-station building, it is proposed to adapt a separate building in Wilkin Street owned by the Department and adjacent to the present sub-station.

The Estates Committee recently received a communication from the Gas Light & Coke Co. offering to replace, at its expense, the existing gas water-heaters on the Brookfield estate by a modern type of gas-heated boiler on free loan, subject to the Council agreeing to retain the installations for not less than ten years and to bear the cost of the necessary maintenance, namely, 4s. per quarter for each heater installed. On the other hand the chief electrical engineer and manager suggested the replacement of the present gas-heaters by 15-gal. thermostatically controlled and lagged electric water-heaters which the Department would be prepared to install for the ten-year period at 4s. per quarter. He pointed out that such an installation would be of distinct advantage to tenants who already, or might subsequently, utilise the supply for all other purposes, as it would entitle such consumers to the benefits of the special "all-electric" tariff, *viz.*:—a "unit" charge of ¾d. during the two summer quarters. In considering this matter, the Estates Committee had regard to the terms of the Gas Light & Coke Company Act, 1933, which provides that local authorities shall not make or impose any restriction with respect to the form of heat, light, power and energy to be supplied or used in any buildings under their control. It was considered, therefore, that it would not be possible for the Council to enter into an agreement such as suggested by the Gas Company and the Electricity Department, inasmuch as tenants must be allowed their choice.

Stoke Newington.—Sanction has been received to a loan of £5,000 for electricity mains and services.

It is proposed that Scale No. 12 (water heating supplies at ¾d. per kWh for all energy consumed) shall be extended to the supply of electricity for charging the batteries of electrically propelled vehicles.

Morecambe.—Better Lighting.—The Corporation is to improve the lighting in Marine Road, at a cost of £1,800.

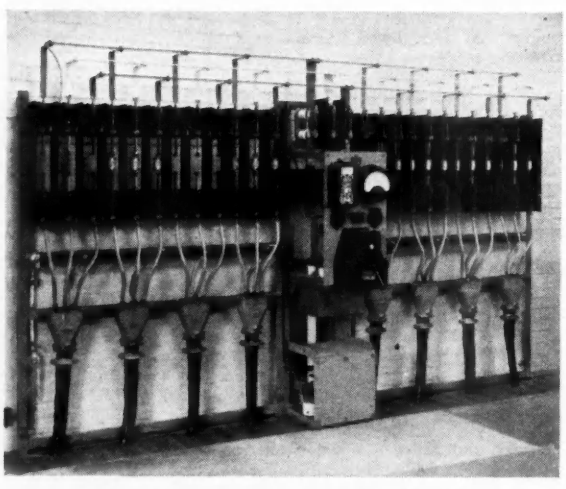
Newark.—Cheaper Electricity.—The Town Council recently approved reductions in charges recommended by the Electricity Committee as follows: Lighting (prepayment meters), 4½d. per kWh; lighting (quarterly accounts), first 250 kWh per quarter 4½d. per kWh; additional consumption at 4d.; power, first 1,000 kWh per quarter 1½d. per kWh; next 1,000 kWh at 1¼d.; all in excess at 1d.; contract rate (business), reduction to £10 per kW of lighting per annum as from October 1st next, subject to new agreements being entered into. Concessions were authorised in respect of all consumers taking supplies under special agreements, and in the case of consumers taking low-voltage supplies on quarterly account (except under special agreement) it was decided to increase the prompt-payment discount from 5 to 10 per cent.

North-Western Counties.—Conference of Small Undertakings.—Forty-four representatives of thirty of the small municipal electricity undertakings in Lancashire, Cheshire and North Wales attended a conference at Manchester last week and appointed a committee to investigate the degree of efficiency attained in the area and to suggest what steps should be taken to secure uniformity in the conditions of supply and in the price. Some of the smaller authorities who take a bulk supply find the charges far from uniform and generally high. The conference claimed that, given efficiency, an undertaking should be preserved irrespective of its size. It called on the Incorporated Municipal Electrical Association to defend the interests of small undertakings against the recommendations contained in the McGowan Report.

North Westmorland.—Overhead Lines in the Lake District.—Recently a special sub-committee was appointed by the Rural District Council to go into the proposal of the Westmorland and District Electricity Co. to erect poles for overhead lines in the vicinity of Ullswater, the chief reason for the scheme being to supply power to the recently reopened Greenside lead mines at Glenridding. The committee reported that the proposed line was visited at various points to ascertain whether poles would intrude on views from the nearest high-

Reorganising a Network

In order to cope with the growth of load in its area (which is almost entirely domestic), the Hazel Grove and Bramhall U.D.C. has considerably stiffened its distribution system which was first put into service in 1924. The scheme, which was



One of the new low-voltage switchboards

recently officially inaugurated, provides for alterations to existing switchgear or new switchgear, high- and low-voltage in three main sub-stations, the construction and equipment of three new transformer stations and alterations to kiosks to comply with the Home Office Regulations. Provision has been made for isolating at each transformer point. About 1,630 yd. of 6.6-kV mains has been replaced by cables of a larger conductor section and 3,700 yd. of new high-voltage cable has been laid.

On the low-voltage system 65 feeder pillars and overground disconnecting boxes have been erected and 10,130 yd. of cable of larger section has been substituted for that formerly in use. The whole scheme, which was designed to ensure flexibility for increased load, cost £26,000 (£20,700 on capital account). With the exception of the buildings and the erection of the 6.6-kV switchgear, the work has been carried out by direct labour under the supervision of the electrical engineer Mr. A. D. Pluck, who designed the layout.

The 6.6-kV switchgear and protective system was supplied by the Metropolitan-Vickers Electrical Co., Ltd., who also manufactured an eight-panel low-voltage switchboard. Other low-voltage switchboards were provided by G. P. Dennis, Ltd. For the transformers Ferranti, Ltd., and the Electric Construction Co., Ltd., were responsible, and for both high- and low-voltage cables British Insulated Cables, Ltd.

The Council takes a supply in bulk from Stockport Corporation. The total mileage of cables in Hazel Grove, Bramhall and Woodford is 15 of high-voltage and 76 of low-voltage. The supply area is completely served by a 6.6-kV ring main and sub-stations have been standardised in design and equipment. A supply is available in practically every street and 4,600 consumers are now connected, domestic wiring and apparatus being obtainable on hire-purchase terms. Showrooms were opened in Hazel Grove two years ago and in Bramhall last year. The whole of the street lighting, consisting of 830 lamps, has been converted to electricity.

way or other places accessible to the public. Numerous deviations were informally agreed to. The line was proposed to be overhead through the Council's area except the last length along the shore of Ullswater and underground under the lake. Where the line was proposed to be taken beyond Howtown to the top of Martindale Hause, *via* the Coombes, the committee was of opinion that it should be underground because it was considered that here an overhead line would interfere most with the natural beauty and, there being no trees, the line would stand alone; also there would be no houses to which connections would be needed. At its meeting recently the Council, after some discussion, decided to offer no objection to the scheme, subject to the submission of detailed plans embodying the suggestions made by the committee.

Shipley.—REFRIGERATION TARIFF.—Electricity used for refrigeration purposes is to be charged for at the same rate as that used for heating, cooking and water heating, namely, ¾d. per kWh.

Sittingbourne and Milton.—OVERHEAD LINE.—The Urban District Council has consented to the Kent Electric Power Co. erecting an overhead 11,000-V transmission line from Bobbing to Iwade.

Todmorden.—STREET LIGHTING.—At a cost of £900 the Electricity Committee is to install thirty-three sodium electric-discharge lamps.

METERS.—Sanction is being sought to borrow £3,000 for meters.

United States.—T.V.A. REVENUE.—Gross revenues of the Tennessee Valley Authority from the sale of power increased from about $1,000,000 in 1935 to approximately $1,600,000 in 1936, states *Electric Light and Power*. Most of the power sold is going to private companies. Out of 98,203,500 kWh generated in December 72,206,000 kWh was sold to private utilities, with the remaining 26,000,000 kWh used for T.V.A. requirements.

Traction

Birkenhead.—SUPPLY TO MERSEY RAILWAY.—Last week the Mayor (Councillor G. S. Prentice) switched on a supply of electricity from the municipal undertaking to the Mersey Railway. This will be utilised during periods of light load, at which times the Railway Company's Shore Road power station will be closed down. In addition to driving the trains, the supply is required for operating pumping plant near

The Mayor of Birkenhead switching on the bulk supply to the Mersey Railway, in the presence of Mr. J. Shaw, general manager and engineer of the company, Mr. F. E. Spencer, borough electrical engineer, and others

Woodside Ferry and electric passenger lifts. Two 750-kW rectifiers convert the 6,600-V a.c. supply to 650-V d.c.

South Shields.—TROLLEY-BUS SCHEME DELAY.—Owing to the scarcity of steel, increased metal prices and the fact that firms are engaged on armament work and are unable to guarantee delivery of normal commercial products, the change-over from tramcars to trolley-buses in South Shields may not be completed until the end of next year. A start has now been made on the change-over on the Stanhope Road-Chichester route and trolley-buses are expected to be in operation next month. After this part of the scheme has been completed work will begin on the Ocean Road-King Street section. The remaining sections, Laygate to Tyne Dock and Fowler Street to Chichester (*via* Westoe), will not be ready until the middle of next year.

Thanet.—TRAMWAY CEASES OPERATION.—The tramway system between Margate, Broadstairs and Ramsgate was closed down last week, buses taking its place.

Increasing Telegraph and Telephone Traffic

Cable-laying and plant construction to meet the demand

TO cope with the increase in telegraph and telephone traffic last year the Engineering Branch of the Post Office had to face a heavy programme of work in connection with the provision of new lines for subscribers and additional channels between one town and another.

Mr. H. Faulkner, superintending engineer for the Birmingham District, discussing this activity in his report, also refers to progress in the transference of services from overhead to underground; during the year 30 miles of main overhead lines were dismantled. Over 95 per cent. of the Post Office circuit mileage in the area is now underground. The conversion of two telephone exchanges from manual to automatic operation was completed, while the installation of equipment in six others was proceeding. Sites for new automatic exchanges were being acquired in six localities. Extensions to equipment were found necessary at 42 exchanges, and considerable additions to line plant became necessary. At December 31st last the total underground mileage in the Birmingham area was 489,795 (against 468,059) and of overhead lines 20,258 (against 19,154). The number of telephones in use at the end of the year was 106,943, an addition of 8,458 (8.59 per cent.). Private branch exchanges increased by 198 to 4,766 and public telephones by 77 to 1,505. Telephone calls numbered 95,800,000 (including 8,270,000 long distance calls), an increase of 9¼ millions. The equipment of the new £600,000 Telephone House was proceeded with, and the ceremonial opening of the building was performed by Mr. Neville Chamberlain on January 21st last. With regard to the telegraph service, the rise in business continued, transactions numbering nearly 12¼ millions, an increase of 17 per cent.

Mr. Faulkner is also superintending engineer for the North Wales Survey District. Two new telephone exchanges were opened in this area during the year, making the total 392 (including 143 automatic). The number of telephones increased by 5,946 to 63,749; exchange lines by 3,436 to 43,131; and call offices by 58 to 1,847. Calls originated numbered 36,353,000, an increase of 12 per cent. Conversions to automatic operation were carried out at 13 exchanges and were in hand at 40 others. In the case of the telegraph service, direct communication was instituted between Chester and Manchester and between Stoke-on-Trent and Leeds and Liverpool.

Mr. A. Morris, superintending engineer, Manchester District, reports that the number of local calls was approximately 83 millions, an increase of 10 per cent., and trunk calls 9½ millions (10.4 per cent. increase). There were altogether 119,439 telephones in the area at December 31st last, an increase of 7.2 per cent. The conversion of a further four exchanges to automatic operation brought the number of consumers' lines attached to such exchanges within a seven miles' radius up to 77 per cent. of the total. The local cable network was substantially augmented during the year and further extensions were contemplated, while in addition to diverting overhead trunk routes underground many other trunk cable works were in hand or were being investigated. Telegraph transactions dealt with at Manchester during the year numbered 11,388,890, an increase of 10 per cent.

In the Liverpool District, for which Mr. Morris is also superintending engineer, telephones at the end of the year numbered 91,545, the increase during 1936 being the highest since 1912 and 52 per cent. of it was in respect of residential lines. There was also an increase of 114 in the number of private branch exchanges, one at Port Sunlight being among the largest in the provinces. An additional 80 kiosks were provided. Work in connection with the conversion of the Liverpool area to "Director" automatic operation is proceeding, and it is thought that the programme for the first group to be opened will form the largest telephone change-over ever undertaken at one time in this country. Other exchanges are to be transferred, or new exchanges opened, in suitable groups at six-monthly intervals. The number of telegrams dealt with daily during the busy season varied between 35,000 and 50,000.

In the report of the North Midland District, for which Mr. A. Wright is superintending engineer, the demand for coloured instruments is analysed. Of the additional 11,590 hand microphones installed 10,942 were black, 444 ivory, 101 green, 100 red, and 3 special colours. The cable-laying and exchange modernisation programme was extensive. During the year the number of telephones increased by 10.19 per cent. to 121,828 and the number of local and trunk calls by 8.34 per cent. to 77,352,000. To deal with the increased telegraph traffic additional lines were provided between post office and telephone exchanges. The bulb and flower trade at Spalding having greatly improved, direct teleprinter circuits were provided between Spalding and Birmingham and also between Spalding and London.

Contract Information

Where "Contracts Open" are advertised in our "Official Notices" section the date of the issue is given in parentheses

Contracts Open

Aberystwyth.—May 5th. Electric lighting installation at Dr. Williams' school, Dolgelly. (See this issue.)

Australia.—Melbourne.—April 27th. State Electricity Commission of Victoria. Transformers. (T.Y. 31219.)*

Bath.—April 7th. City Council. Electrical supplies for one year. (March 26th.)

Brechin.—Town Council. Electric lighting in forty-eight houses. W. W. Young, burgh surveyor.

Bridlington.—April 8th. Town Council. Electrical materials for one year. (March 26th.)

Brighouse.—April 17th. Electricity Committee. Transformers, transformer kiosk, &c., and h.v. cucibles. (See this issue.)

Cardiff.—April 19th. Electricity Department. Electrically driven grab crane, with accessories. (See this issue.)

Carlisle.—April 6th. Corporation. Stoneware conduits and cable covers for one year. (March 19th.)

Dumfries.—April 22nd. Borough Council. Two 4-panel switchboards. (See this issue.)

Dundee.—April 6th Electricity Department. Meters, domestic appliances, control units for electric cookers and double-pole iron-clad switches for one year. (March 19th.)

Edinburgh.—April 8th. Corporation. Electrical installation in extensions to St. Francis's school, Craigmillar. City architect.

Egypt.—Cairo.—April 20th. Mechanical and Electrical Department, Ministry of Public Works. Two electrically driven pumping units, with auxiliary machinery at Drain No. 7 pumping station, Northern Part of Gharbia Province. Chief inspecting engineer, 41, Tothill Street, London, S.W.1 (deposit £2 1s.).

May 18th. Pumping stations extensions at Drains No. 1 and No. 11, and modifications of Seru and Faraskour outdoor transformer stations and increasing the number of insulator units for Faraskour transmission line. Each of the stations includes two electrically driven pumping units with auxiliary machinery, &c. Chief inspecting engineer (deposit £2 1s.).

Fleetwood.—Borough Council. Cables for one year; also four transformers, two 6,600-V cubicles and two l.v. distribution boards. (March 26th.)

Folkestone.—April 10th. Corporation. Internal and external wiring of 453 houses and flats. (March 19th.)

Guildford.—April 5th. Electricity Department. H.v. and l.v. cables for one year. (March 26th.)

Heston and Isleworth.—April 7th. Electricity Department. Cables and two 600-kVA transformers. (March 26th.)

Kirkcaldy.—April 12th. Town Council. Electrical supplies for twelve months. (See this issue.)

Leyton.—April 16th. Corporation. Removing existing fittings, respacing, wiring and reinstating the electric lighting installations at two schools. (See this issue.)

London.—Wandsworth.—Borough Council. Filtration plant, electrical installations, &c., at the swimming pool and buildings at King George's park. E. J. Elford, borough engineer, 215, Balham High Road, S.W.17.

Stepney.—April 26th. Borough Council. Electrical supplies for twelve months. (See this issue.)

Lowestoft.—April 9th. Electricity Department. Cables. (March 26th.)

Manchester.—April 13th. Transport Committee. Fifteen 6-wheel chassis, complete with all electrical equipment, including trolley gear and power wiring, suitable for double-deck, top-covered-type sixty-eight-seater trolley-buses; fifteen metal bodies. Eighteen 4-wheel chassis, with electrical equipment, &c., suitable for double-deck, top-covered-type fifty-six-seater trolley-buses; also eighteen metal bodies. General manager, Corporation Transport Department, 55, Piccadilly.

April 12th. Electricity Committee. One portable venturi meter for boiler testing at the Barton power station. (See this issue.)

Marple.—April 6th. U.D.C. Cables, switchgear and transformers. J. K. Law, manager, Council Offices.

Mexborough.—April 20th. U.D.C. Electricity Department. E.h.v. and l.v. p.i. cables for the period ending March 31st, 1938. (See this issue.)

Middlesbrough.—April 19th. Electricity Department. 250-kVA transformers and 11,000-V circuit-breakers for one year. (March 26th.)

Morecambe and Heysham.—April 23rd. Borough Council. E.h.v. and l.v. overhead lines. (See this issue.)

New Zealand.—Wellington.—April 29th. Post and Telegraph Department. Secondary cells. (T.Y. 31220.)*

May 4th. Public Works Department. Insulators. (T.Y. 31232.)*

May 11th. Two switch and metering cubicles (T.Y. 31233.)*

June 1st. Two electrically driven centrifugal pumps, with necessary electrical equipment, switchboard and control apparatus. (T.Y. 2413.)*

June 15th Transformers. (T.Y. 31234.)*

Auckland.—June 8th. Harbour Board. Three 5-ton electric semi-portal jib cranes. C. R. Butters, c/o H. H. Lloyd & Co., 41, Cheapside, London, E.C.2.

Norfolk.—April 5th. County Council. Engineering works in connection with the East Dereham Central Isolation Hospital. (March 26th.)

Northern Ireland.—Belfast.—April 19th. Harbour Commission. Two double jib and one single jib 1-ton electric cranes. Harbour engineer, Harbour Office.

Portsmouth.—April 20th. Electricity Undertaking. Twelve months' supply of switchgear. (March 26th.)

Illuminated Coronation display. (March 26th.)

Prestatyn.—April 7th. U.D.C. Electricity Department. Twelve months' supply of electrical stores. (March 26th.)

Sheffield.—April 14th. Electricity Committee. Transformers. (See this issue.)

South Africa.—Pretoria.—April 9th. Public Works Department. Cable. (T.Y. 31231.)*

Durban.—April 14th. Electricity Department. 6.600-V metal-clad switchgear. (See this issue.)

Southend-on-Sea.—April 12th. Corporation. Electric refrigerator cabinets. (See this issue.)

Swindon.—April 15th. Electricity Department. One year's supply of p.i. cables. (March 19th.)

Wallasey.—April 13th. Borough Council. Switchgear. (March 19th.)

Warrington.—April 19th. Electricity and Transport Committee. Transformers. (See this issue.)

West Riding.—April 5th. County Council. L.p. hot water apparatus and electric lighting at Hemsworth Kinsley Council school extension. Education officer, County Hall, Wakefield.

April 10th. County Education Committee. Electric lighting in four school houses at Rossington. A. J. Dempster, divisional clerk, Winchester House, Scot Lane, Doncaster.

Whitworth.—April 12th. U.D.C. Transformer and metering set, cable, joint boxes, cut-outs and compound. (March 26th.)

* Further particulars from the Department of Overseas Trade (Inquiry Room), 35, Old Queen Street, London, S.W.1.

Contracts Closed

Barking.—Electricity Committee. Recommended. Pilot cable (£286).—Hackbridge Cable Co. Switchgear at three substations (£606 each).—A. Reyrolle & Co.

Cheshunt (Waltham Cross).—U.D.C. Accepted. Electric lighting in 366 houses (£2,466).—Holmes & Larkinson.

Brighton.—Electricity Committee. Accepted. Switchgear.—Met.-Vick. Elecl. Co. Transformer (£8,650).—B.T.H. Electric lamps for street lighting (£1,113).—J. Ismay & Sons. Transformer (£683).—Hackbridge Electric Construction Co. Cables (£474).—Wm. Geipel, Ltd.

Ilford.—Electricity Committee. Recommended. Cables for twelve months.—Metropolitan Cable & Construction Co.

Keighley.—Electricity Committee. Accepted. Transformers, motors and starters for twelve months.—G.E.C.

Lennoxtown (Glasgow).—Accepted. Electrical work in sixty houses.—A. H. Smillie.

Linlithgow.—County Council. Accepted. Electrical work at the new County Buildings (£2,096).—Greig Bros.

London.—Fulham.—Electricity and Lighting Committee. Recommended. Extension of the "Mulsifyre" system of fire protection to cover the No. 3 turbo-alternator and other auxiliary switchgear in the turbine room and feed pump basements at the further extension of the new power station (£963).—Mather & Platt, Ltd. High pressure pump and accessories at the new station: Pump and motor (£3,272).—Mather & Platt, Ltd.; pipework (£1,431).—Stewarts & Lloyds, Ltd.; switchgear and cables (£835).—Malcolm & Allan, Ltd. Fire protection equipment at the Barclay Road sub-station (£509).—Pyrene Co.

Accepted. Feeder control panels at the central sub-station (£369).—English Electric Co.

Hammersmith.—Electricity Committee. Recommended. Supplies for twelve months: Stoneware conduit.—Albion Clay Co. Insulating compound.—Dussek Bitumen and Taroleum. Cables.—Siemens Bros. & Co.; Hackbridge Cable Co.; Pirelli-General Cable Works. House service joint boxes, &c.—W. Lucy & Co. Draw-box frames and covers.—Henley's; A. C. Woodrow & Co. Switches and lampholders, &c.—Brown Bros. Insulating tapes.—G.E.C. Cooker control switches, &c.—J. H. Tucker & Co.; Sloan Electrical Co. Insulated wires.—Mersey Cable Works. Meter boards.—Caxton Wood Turnery. Meters.—Aron Electricity Meter; Measurement, Ltd.

Housing, Improvements and Development Committee. Electrical installations in dwellings in Emlyn Gardens (£5,047).—F. Goodchild.

Works, Parks and Cemeteries Committee. Mercury-vapour discharge lamps, steel standards, and other fittings for the public lighting of Westway, including connections to mains:

	£		£
British Thomson-Houston Co. ...	*899	Overhead, Ltd.	1,225
General Electric Co. Recommended	1,204	Electrical Installations	1,261
Edison Swan Electric Co. ...	1,221	Harland & Wolff	1,285

* Does not comply with specification.

L.C.C.—Wiring of fittings for rewiring boiler house, laundry and workshops at St. Giles' Hospital, Camberwell:

	£		£
A. J. Hewens & Sons. Accepted ...	425	Gillham & Jones	534
Bell Bros. & Co. (London) ...	435	Pinching & Walton	539
Carr Bros.	455	A. Cozens	541
Malcolm & Allan (London) ...	500	B. French	549
Electrical Installations	520	Davis Myer & Co.	552
A. Meckhonik	529		

Electric bed lift at St. Giles' Hospital, Camberwell:

	£		£
Marryat & Scott	*1,130		
Waygood-Otis, Ltd. Accepted ...	**1,164**	J. & E. Hall	*1,233
Pickerings, Ltd....	1,205	Express Lift Co.	*1,234

* Qualified.

Wiring and fitting for alterations and additions to electric lighting, power, telephone and fire alarm systems at St. George-in-the-East Hospital, Wapping:

	£		£
F. G. Edey & Co. Accepted ...	**1,379**	J. E. Swann & Co.	1,609
Grant & Blake	1,398	H. J. Cash & Co.	1,610
W. H. Gaze & Sons	1,407	Evans & Shea	1,615
W. J. Furse & Co. (London) ...	1,523	W. Steward & Co.	1,845
Malcolm & Allan (London) ...	1,583		

Wiring and fittings, &c., at the new elementary school and schoolkeeper's house on the East Dulwich estate, Camberwell:

	£		£
Anderton, Angell & Co. Accepted	**936**	H. J. Cash & Co.	1,044
Higgs & Hill	981	Berkeley Electrical Engg. Co. ...	1,051
G. W. Taylor & Co.	996	S. Reed & Sons	1,072
Holliday & Son (Electrical) ...	1,016	G. E. Wallis & Sons	1,111
Atozed (Kingston)	1,037		

Malton.—R.D.C. Housing Committee. Recommended. Wiring 20 houses in various parishes (£201).—Gibson & Cossins.

Middlesbrough.—Town Council. Accepted. Cable.—Hackbridge Cable Co. Two circuit-breakers.—English Electric Co.

Middlesex.—Health Committee. Electrical installation at the Central County Hospital extension:

	£		£
Commercial Light, Heat & Power Co.	*20,379	F. H. Wheeler & Co.	22,927
Colston Electrical Co. Recommended	**22,411**	F. G. Edey & Co.	23,212
		B. French	23,360
		G. A. Weston	23,712

* Incomplete regarding sureties, etc.

X-ray equipment for the West Middlesex County Hospital:

	£		£
Solus Electrical Co.	3,307	Newton & Wright	4,089
General Radiological & Surgical Apparatus Co. Recommended	**3,559**	Victor X-Ray Corporation ...	4,213
		Watson & Sons (Electro-Medical)	4,409
Schall & Son	3,801		

Accepted. X-ray equipment for Harefield Sanatorium (£2,468).—Victor X-ray Corporation.

Midlothian.—County Council. Accepted. Electrical work in eighty-four houses (£650).—J. Cairns.

North Shields.—Town Council. Accepted. Electrical installations in 152 houses on the Ridges estate (£636).—J. M. Mylotte.

Seaham Harbour.—U.D.C. Accepted. Cable and lamps for one year.—Edison Swan Electric Co.

Shipley. — Highways Committee. Accepted. Centralised street lighting control apparatus (£141).—Automatic Telephone & Electric Co.

West Lothian.—County Council. Accepted. Electrical work at the new police headquarters (£399).—W. A. Smith & Co.

Forthcoming Events

Institution of Electrical Engineers.—Thursday, April 8th. Institution, London, W.C.2. 6 p.m. "The Examination and Recording of the Human Electrocardiogram by Means of the Cathode-Ray Oscillograph." Mr. D. Robertson.

Meter and Instrument Section.—Friday, April 2nd. Institution, London, W.C.2. 7 p.m. "Coin Mechanisms, with Particular Reference to Electricity Meters." Messrs. J. Prince and M. Whitehead.

Mersey and North Wales (Liverpool) Centre.—Monday, April 5th. The University, Liverpool. 7 p.m. Annual general meeting.

South Midland Centre.—Monday, April 5th. James Watt Memorial Institute, Birmingham. 7 p.m. Annual general meeting. "Modern Factors Affecting Electricity Costs and Charges." Mr. J. A. Sumner.

North Midland Centre.—Tuesday, April 6th. Hotel Metropole, Leeds. 7 p.m. Annual general meeting.

North-Western Centre.—Tuesday, April 6th. Engineers' Club, Manchester. 7.15 p.m. Annual general meeting. "The Metering of Mercury Arc Rectifier Supplies and Outputs." Mr. C. Dannatt.

Wireless Section.—Wednesday, April 7th. Institution, London, W.C.2. 6 p.m. Lecture by Dr. B. van der Pol.

Electrical Power Engineers' Association (*London Western Section*).—Saturday, April 3rd. St. Ermin's Hotel, London, S.W.1. 6.30 for 7 p.m. Annual dinner.

Northern Division.—Saturday, April 3rd. Midland Hotel, Manchester. 5.30 for 6 p.m. Dinner and dance.

Association of Mining Electrical Engineers (*London Branch*).—Tuesday, April 6th. Junior Institution of Engineers, London, S.W.1. 6.30 p.m. "Electric Shock and its Effects Upon the Human Body." Messrs. S. W. Fisher and G. M. Harvey.

Institution of Engineers & Shipbuilders in Scotland.—Tuesday, April 6th. Glasgow. Annual general meeting.

Electrical Association for Women.—Wednesday to Saturday, April 7th to April 10th. Bristol. Annual conference.

Institution of Heating & Ventilating Engineers.—Wednesday, April 7th. Institution of Mechanical Engineers, London, S.W.1. 7 p.m. "Some Problems in the Heating and Ventilation of Glasshouses." Messrs. W. F. Bewley and E. S. Shoults.

Institute of Wireless Technology (*London and Home Counties Section*).—Thursday, April 8th. Institute, London, W.C.1. "Horn Loaded Loudspeakers." Mr. Voigt.

Electrical Industries Benevolent Association.—Friday, April 9th. Savoy Hotel, London, W.C.2. Annual general meeting and luncheon.

Institution of Engineers-in-Charge.—Friday, April 9th. Holborn Restaurant, London, W.C.2. Annual dinner.

Association of Supervising Electrical Engineers.—Saturday, April 10th. Queen's Head Hotel, Maidstone. 3 p.m. "Compulsory Wiring Regulations and Registration." Mr. J. Munro.

Notes

International H.V. Conference

Over one hundred reports and papers emanating from twenty different countries are to be presented at the Conference Internationale des Grand Réseaux Electriques à Haute Tension, which is to be held in Paris from June 24th to July 22nd next. From the first list, just published in the *Revue Générale de l'Eléctricité*, we learn that contributions from this country have already been promised by: The National Physical Laboratory, on the behaviour of dielectrics, insulators and safety protection devices submitted to jolting and vibration waves; by Mr. E. T. Norris, on the protection of electrical apparatus against high excess voltage; by Messrs. G. J. Beaver and E. L. Davey, on gas-filled cables; by Mr. P. J. Ryle, on a study of the action of lightning on electric power transmission masts; by Mr. C. W. Marshall, on the results of tests on insulators connected with the English grid system; by Messrs. W. G. Hawley and H. M. Lacey, on excess voltage tests on a 33-kV English grid transmission line; by Messrs. W. B. Whitney and L. Gosland, on the use of the cathodic oscillograph in connection with h.v. transmission systems; by Messrs. B. H. Leeson and M. Leyburn, on the rapid and automatic insulation of faults in power production systems; and by Messrs. A. E. W. Austen and H. G. Taylor, on the protection of animals against the effect of the voltage gradient surrounding earthing electrodes.

The Electrical Association for Women

The successful launching of a Home Workers' Campaign is an outstanding item recorded in an extract of the twelfth annual report of the Electrical Association for Women which has been sent to all members. Great interest in the Campaign is said to have been shown by educational authorities and courses are being arranged in many centres. At Croydon and Wolverhampton the first courses have been completed and seventeen of the new certificates have been awarded. Useful work, too, has been continued in connection with house matters. The Birmingham Branch co-operated with the local Electricity Department in the equipment of an electrical exhibition house, while a meeting was held at Headquarters for the Hundred New Towns Association. An experimental film has been made to show how the application of motion study principles allied to intelligent kitchen planning may be of use in the home. During the year regional conferences were held all over the country. The summer school for teachers was held at King's College of Household and Social Science and a three-days' course for senior demonstrators was organised in conjunction with E.D.A. and E.L.M.A. A particularly satisfactory feature of the report is the statement that there is now an almost universal tendency to demand the E.A.W. certificate or diploma from prospective demonstrators and also that there is a satisfactory trend towards higher salaries; it is hoped that a schedule of salaries drawn up by a sub-committee will be adopted. Thirty schools are now affiliated to the Association and great interest was aroused by the first essay competition for the Lady Mount Temple Cup. Area organisers continue to do useful work and since the last report ten new branches and two units have been formed.

About 160 members of the Gravesend, West Kent, Ashford, Tunbridge Wells and Sevenoaks Branches attended the half-yearly Kent Group meeting at Gravesend on March 22nd. After listening to an address by Mrs. Pender Chalmers on "Public Speaking," the visitors were entertained to luncheon by W. T. Henley's Telegraph Works Co., Ltd., over whose Gravesend works they were conducted during the afternoon.

Appointments Vacant

Meter tester and repairer for Barking Electricity Department.

Girls with experience of selling electrical appliances and fittings for Salford Electricity Department.

Mains assistant engineer for Scarborough Electricity Department.

Meter mechanic for Newport (Mon.) electricity undertaking.

Junior mains assistant and domestic appliance representative for Hornsey Electricity Department.

Junior control engineer for the County of London Electric Supply Co., Ltd

Meter repairer and tester and plumber-jointer for the Stewartry of Kirkcudbright Electricity Department.

Shift charge engineer for Heston and Isleworth Electricity Department.

Lady demonstrator for Birmingham Electric Supply Department.

Canvasser for Long Eaton Electricity Department.

(See our classified advertisements.)

Our Service Department

EVERY day inquiries of all kinds are received by the Editors, the bulk of them relating to the producers of specified classes of electrical goods. We are able to reply to most of these with the aid of our extensive records, but in a few cases we have to seek the assistance of our readers. This week we have been asked for the names and addresses of manufacturers of the following:—

Arc Company, makers of "APM" lamps.

DERLENCO reflectors.

Readers should enclose stamped addressed envelopes when making their inquiries.

Our Personal Column

Electrical men are invited to keep readers of the "Electrical Review" posted concerning their movements

Mr. G. W. Nicholson, the author of the article on "Oxidation of Fusible Elements," on page 500, received his technical education at the Elswick Mechanics' Institute, Newcastle-upon-Tyne, and served an apprenticeship with Sir W. G. Armstrong Whitworth & Co., Ltd. After some drawing office experience with that company he joined the staff of Messrs. A. Reyrolle & Co., Ltd., and five years later went to the Park Royal Engineering Co., Ltd., as assistant to the managing director. Subsequently he was appointed general manager of Cantie Switches, Ltd., and at a later date secured a position as manager of a concern not connected with switchgear. He returned to this business, however, and is now with the General Electric Co., Ltd., carrying out investigations on switchgear manufacture at Witton, Birmingham.

Mr. G. W. Nicholson

Mr. Robert F. Bruce, managing director of the Saxonia Electrical Wire Co., Ltd., is chairman of a committee which is organising a Coronation Ball to be held at the Royal Naval College, Greenwich, on May 28th. A number of prominent people, including Lord Queenborough and the Earl of Dartmouth have promised to attend and the proceeds are to go to two local hospitals and the Greenwich Workshops for the Blind. Tickets (including running buffet) are 15s. each, and can be obtained from Mr. Bruce.

Mr. J. Stinton Jones writes correcting a statement which appeared in this column in our issue of March 19th. He did not erect the sub-station for the Moscow tramways, but went to Russia as an instrument expert and to assist Major Stanley M. Mohr, who was responsible for the erection of the sub-station and who is now managing director of the Micanite & Insulators Co., Ltd.

Mr. T. Hetherington, mains assistant with the Watford Corporation Electricity Department, has been recommended for the appointment of mains engineer in the Hammersmith Corporation Electricity Department, at a salary of £447 per annum.

Mr. R. Thistleton, of the Keighley Corporation Electricity Department, and **Mr. H. C. Ashworth,** of the North Eastern Electric Supply Co., have been appointed charge engineers to the Portsmouth Corporation electricity undertaking.

Mr. T. Moore, electrical engineer to the Sutton Coldfield Corporation, who has reached the age of sixty-five, has had his term of service extended for twelve months.

Mr. W. Millinger has been transferred from the Bristol and South Wales districts to the Midlands, where he will represent Crompton Parkinson, Ltd., as the company's cable specialist.

[*Jerome, Ltd.*

Mr. W. Millinger

Mr. W. H. Harrison, assistant vice-president, Department of Operation and Engineering, American Telephone and Telegraph Co., is proposed as the next president of the American Institute of Electrical Engineers by the Institute's Nominating Committee.

Mr. W. F. Higgs, a director of Higgs Motors, Ltd., has been recommended for adoption as Unionist candidate for West Birmingham in the Parliamentary by-election caused by the death of Sir Austen Chamberlain. Mr. Higgs is a member of the Birmingham City Council.

Mr. W. J. Williams, M.I.E.E., M.I.Mech.E., M.I.Struct.E., Adviser on Electricity, Malay States, left Malaya on March 27th for England on leave prior to retirement. Mr. Williams's address in England for about six months will be 27, Queenberry House, Friar's Lane, Richmond, Surrey.

Mr. H. S. Lamburd, managing director of Asea Electric (N.Z.), Ltd., of Wellington, is *en route* to this country, with his wife and family, on the s.s. *Orion* for a business trip and for the Coronation. While here he will visit various Continental countries, chiefly Sweden, where the parent A.S.E.A. works are situated. Later he will be at the Walthamstow Fuller-Asea works. Mr. Lamburd will return to New Zealand, *via* the United States, in the *Queen Mary* in August. During his tour he will investigate in Europe and America electrical problems of special interest to New Zealand. Mr. Lamburd is a member of a number of electrical trade and other associations in New Zealand and is president of the Wellington Electrical Traders' Association (Wholesale Section).

Mr. J. C. Horsford, who represents W. T. Henley's Telegraph Works Co., Ltd., on the engineering sales side, has removed to "Moul Va," Priory Hill Avenue, Sudbury, Middlesex (telephone: Arnold 1464).

Lord Ebbisham has resigned from the board of the Telegraph Condenser Co., Ltd., owing to increasing pressure of his other activities.

Obituary

Brig-Gen. Sir Capel Holden.—The death occurred on March 30th at the age of eighty-one of Brigadier-General Sir Capel Holden, F.R.S. Sir Capel was the inventor of many instruments and apparatus for artillery and electrical science. He was elected F.R.S. in 1895, was sometime member of the Council and vice-president of the Institution of Electrical Engineers, and in 1927 was president of the Radio Society of Great Britain. He served on the board of the National Physical Laboratory from 1907 to 1911.

Mr. R. H. Thorpe, vice-president of the Otis Elevator Co., died on March 29th in a London nursing home, at the age of seventy-six. He was a pioneer in the introduction of high-pressure hydraulic lifts and entered the lift business in London and later in New York. He returned to England and was engaged in the installation of lifts and escalators on the London tube railways. Mr. Thorpe was also a director of Waygood-Otis, Ltd., and Waygood-Otis (South Africa). He was a M.Inst.C.E., and M.Am.Soc.M.E.

Mr. H. A. Couves.—Mr. Harry Augustus Couves, M.I.E.E., general manager and director of the North-Eastern Electric Supply Co., Ltd., died suddenly in London on March 25th in his 62nd year. The funeral ceremony took place quietly at Walmer (Kent) on Tuesday last. Mr. Couves, who was a bachelor, was born in Kent. He served his apprenticeship at the Blackwall Works of John Stewart & Co., Ltd., and received his electrical training with Siemens Bros., at Woolwich. He joined the staff of Merz & McLellan in 1901 and went north to take up an appointment at their Newcastle office. Five years later he was appointed engineer of the Power Department of the Newcastle-upon-Tyne Electric Supply Co., Ltd. (now the North-Eastern Electric Supply Co., Ltd.), and became general manager of the company in 1926. He was elected to the board in 1934. Mr. Couves was a member of the National Consultative Committee of the Central Electricity Board, chairman of the North-East England District Consultative Technical Committee of the C.E.B., vice-president and member of the Council of the Incorporated Association of Electric Power Companies, member of the National Joint Industrial Council and the National Joint Board for the Electricity Supply Industry, and a member of the Investigation Committee appointed under the Northumberland District (Coal Mines) Scheme of 1930. He was a member of the I.E.E., the Iron and Steel Institute, the Institution of Mining Engineers, the Association of Mining Electrical Engineers, the North-East Coast Institution of Engineers and Shipbuilders, and a life member of the Electrical Industries Benevolent Association. For many years he resided at Gosforth, Northumberland.

[*Elliott & Fry*

The late Mr. H. A. Couves

Monsieur P. Janet.—The death is reported from Paris at the age of seventy-four years of Monsieur Paul Janet, the director of the French Laboratoire Centrale d'Electricité, founder of the Ecole Superieure d'Electricité, honorary president of the Société Francaise des Electriciens and a Free Member since 1919 of the French Academie des Sciences. Monsieur Janet was one of the best known electricians in France, and had played an important part in the building up of the electrotechnical industry in that country.

Financial Section

New Companies. Official Returns of Capital. Debenture Charges. Reports of Electrical Companies. Dividend Announcements. Transactions in Stocks and Shares

New Companies Registered

Cairns (Newcastle), Ltd.—Private company. Registered March 24th. Capital, £20,000. Objects: To acquire the business of a heating, electrical and plumbing contractor heretofore carried on by R. W. Cairns at 23, Picton Place, Newcastle-on-Tyne. The subscribers are: R. W. Cairns, "Tweedholme," Picton Place, Newcastle-on-Tyne; and W. M. Longshaw, 5, Roseworth Avenue, Gosforth, Newcastle-on-Tyne. R. W. Cairns is to be permanent governing director so long as he holds one-fourth of the issued capital. Solicitors: Graham, Proom & Smith, 2, Savile Place, Newcastle-on-Tyne, 1.

Market Electric Stores, Ltd.—Private company. Registered March 24th. Capital, £100. Objects: To acquire the business of F. H. McDermott, trading as the Market Electric Stores at 21, Peter Street, Warrington, and to carry on the business of manufacturers and repairers of and dealers in all types of electrical machinery equipment and accessories, gramophones, vacuum cleaners, &c. The directors are: F. H. McDermott (permanent) and Mrs. B. M. McDermott, both of 198, Knutsford Road, Warrington.

Newton Distributors (Manchester), Ltd.—Private company. Registered March 24th. Capital, £100. Objects: To carry on the business of radio and television engineers, dealers and merchants, electrical engineers, electricians, &c. The permanent directors are: J. Prior, 7, Brazennose Street, Manchester; and A. Jaffe, 66, Northumberland Street, Salford, 7. Solicitor: J. Prior.

G.R.S. Co., Ltd.—Private company. Registered March 24th. Capital, £250 in £1 shares. Objects: To carry on the business of repairers, hirers and manufacturers of and dealers in electrical and mechanical apparatus, accessories and components, and particularly wireless sets and valves, gramophones, television sets, &c. The directors are: A. E. Grainger, Cornerways, Long Lane, Hillingdon, Mdx.; and Lieut. H. F. S. Lowthorpe-Lutwidge, 29c, Hogarth Road, Earls Court, S.W.5. Registered office: Condor House, St. Paul's Churchyard, E.C.4.

Desmond Curry & Co., Ltd.—Private company. Registered March 24th. Capital, £200. Objects: To carry on the business of dealers in and distributors and manufacturers of electrical or mechanical plant, appliances, apparatus, accessories and spare parts, &c. The directors are: R. J. Climpson, 42, Museum Street, W.C.1; H. H. Pilgrim (permanent), "Mayfair," Cedar Lawn Avenue, New Barnet; S. C. Howard (permanent), and D. N. Bateman, addresses not stated. Registered office: 42, Museum Street, W.C.1.

Radiovision, Ltd.—Private company. Registered in Edinburgh March 19th. Capital, £500. Objects: To carry on the business of general merchants, exporters and importers, &c. The subscribers are: W. Nightingale, 18, Moorehouse Avenue, Knightswood, Glasgow, and E. W. Cassels, 9, Hazelden Gardens, Cathcart, Glasgow. W. Nightingale is the first director. Registered office: 74, York Street, Glasgow.

Electraflora, Ltd.—Private company. Registered March 20th. Capital, £1,000. Objects: To carry on the business of manufacturers of artificial flowers, bouquets, fruit and decorations, electrical and other lamps, reflectors and electrical plant, fittings and accessories, electricians, &c. The subscribers are: A. Spencer, 47, Beverley Gardens, Stanmore, Middlesex, and D. B. Hicks, 21, Launceston Road, Greenford. Secretary: C. A. Henry. Registered office: 161, Vauxhall Bridge Road, S.W.1.

Cosway (Sales), Ltd.—Private company. Registered March 20th. Capital, £100. Objects: To adopt an agreement between G. P. Cosway, Ltd., G. P. Cosway and A. White, and to carry on the business of general, mechanical and electrical engineers and contractors, gear cutters, electric and oxy-acetylene welders, founders, smiths, and machinists, &c. The subscribers are: G. P. Cosway, Daybrook, Manor Park Road, Nuneaton, and C. A. Hazeltine, St. Olaves, Mount Court Road, Nuneaton. Secretary: C. A. Hazeltine. Registered office: Princes Street, Nuneaton, Warwickshire.

Reo Radio, Ltd.—Private company. Registered March 19th. Capital, £5,000. Objects: To carry on the business of manufacturers of and dealers in wireless, television, sound and photographic apparatus, electrical, mechanical and scientific engineers, &c. The subscribers are: R. Myers, 195, Queens Drive, Wavertree, Liverpool, 15, and I. Stonefield, 20, Lulworth Road, Southport. R. Myers signs document as director. Solicitors: Alfred Bieber and Bieber, 14, Cook Street, Liverpool.

Safeguard Electrical Appliances (Dewsbury), Ltd.—Private company. Registered March 19th. Capital, £10,000. Objects: To carry on the business of mechanical and electrical engineers, washing machine manufacturers, toolmakers, brassfounders, &c. The permanent directors are: J. D. Ingram, Northfields, Dewsbury, W. Winn, Leeds Road, Dewsbury, R. H. Ingram, Birkdale Road, Dewsbury, and H. France, Westfields, Mirfield. J. Brown & Co., Ltd., may, so long as they hold £500 ordinary shares, appoint a successor to H. France in the event of his death or resignation. Secretary: H. Threlfall. Registered office: Anchor Foundry, Dewsbury.

W. R. Stone, Ltd.—Private company. Registered March 23rd. Capital, £3,000. Objects: To carry on business as electrical engineers and general electrical installation contractors, &c. The subscribers are: W. R. Stone, 124, Stanstead Road, Hoddesdon, Herts, and two others. W. R. Stone is sole director.

H. W. Stanton, Ltd.—Private company. Registered March 15th. Capital, £100. Objects: To carry on the business of manufacturers of and wholesale and retail dealers in wireless transmitting and receiving sets, television sets and wireless and electrical plant, &c. The subscribers are: H. W. Stanton, 5, Royal Road, West Stanley, Co. Durham, and G. Fryer, Anthony Street, Stanley, Co. Durham. H. W. Stanton is the first director. Registered office: 5, Royal Road, West Stanley, Co. Durham.

Battery Services, Ltd.—Private company. Registered March 15th. Capital, £500. Objects: To carry on the business of manufacturers of and dealers in electrical accumulators, batteries, acids and containers, &c. The directors are: D. W. C. Drabble, Bank House, Bath Street, Bakewell, and W. M. O'Brien, 17, Manley Road, Whalley Range, Manchester. Secretary: W. O'Brien. Registered office: 7, Brazennose Street, Manchester, 2.

Micox Electrical Equipment, Ltd.—Private company. Registered March 13th. Capital, £1,000. Objects: To carry on the business of manufacturers, distributors and merchants of electrical machines, motors, machinery, plant, apparatus, tools, equipment and accessories, &c. The subscribers are: A. J. Moss, 45, Birchdale Road, Forest Gate, E.7, and L. E. Burgess, 52, Greyswood Street, Streatham, S.W.16. Registered office: Suffolk House, Laurence Pountney Hill, E.C.4.

Morton Industries, Ltd.—Private company. Registered March 17th. Capital, £100. Objects: To carry on the business of radio and wireless and television merchants, manufacturers, fitters, experts and contractors, electricians and electrical engineers, &c. The permanent directors are: M. Lipman, 15, Sneyd Road, Cricklewood, N.W.2, and Mrs. G. N. Samson, 86, Highlands Heath, Putney, S.W. Secretary: Mrs. G. N. Samson. Registered office: 15, Sneyd Road, Cricklewood, N.W.2.

Sydney W. Thomas, Ltd.—Private company. Registered March 17th. Capital, £100. Objects: To acquire the business of an electrician and wireless dealer carried on by S. W. Thomas at "Bralo," South Parade, Tenby. The subscribers are: S. W. Thomas, "Bralo," South Parade, Tenby, and D. T. Owen, C.A., 49, King Street, Carmarthen. S. W. Thomas is to be permanent managing director.

Returns of Electrical Companies

British Acheson Electrodes, Ltd.—The nominal capital has been increased by the addition of £100,000 in £1 ordinary shares beyond the registered capital of £150,000. To March 3rd, 1936, 150,000 shares had been issued and fully paid up. The shareholders included: Thos. Firth and John Brown, Ltd. (15,771); Hadfields, Ltd. (5,772); Kayser Ellison & Co., Ltd. (4,628); Brown Bayley's Steel Works, Ltd. (2,837); Samuel Osborn & Co., Ltd. (1,702); English Steel Corporation, Ltd. (14,069); and Dominion Metallurgical Co., Ltd., of Toronto (105,000).

Litholite Insulators and St. Albans Mouldings, Ltd.—Deposit on March 4th, 1937, of deeds Lot 5, Delectaland, Sandown Road, Watford, to secure all moneys due or to become due from the company to Barclays Bank, Ltd.

Neosid, Ltd.—The nominal capital has been increased by the addition of £1,000 in £1 7 per cent. non-cumulative participating preference shares beyond the registered capital of £1,000.

Radioquipment Finance, Ltd.—The nominal capital has been increased by the addition of £1,000 beyond the registered capital of £1,000. The additional capital is divided into 100 ordinary shares of 1s. and 995 cumulative preference shares of £1 each.

Multitone Electric Co., Ltd.—Capital, £16,000 in £1 shares. Return dated December 10th, 1936. 15,050 shares taken up. £10,050 paid, £5,000 considered as paid. Mortgages and charges nil.

H.P. Electrical Co., Ltd.—Capital, £1,000 in £1 shares. Return dated September 21st, 1936. 654 shares taken up. £654 paid. Mortgages and charges nil.

Nivalight (1928), Ltd.—Capital, £5,000 in £1 shares. Return dated December 28th, 1936. All shares taken up. £5,000 paid. Mortgages and charges nil.

Community Radio (1928), Ltd.—Capital, £30,000 in £1 shares. Return dated October 20th, 1936. 18,288 shares taken up. £18,188 paid, £100 considered as paid. Mortgages and charges £1,500.

Astralite Electrical Products, Ltd.—Debenture charged on the company's undertaking and property, including uncalled capital, dated February 24th, 1937, to secure £20,000. Holders: E. Elliott, Ltd., 315, Summer Lane, Birmingham.

E. C. Stokes, Ltd.—Particulars filed of £500 debentures, authorised February 20th, 1937, charged on the company's assets, present and future, including uncalled capital, the whole amount being now issued.

Brush Electrical Engineering Co., Ltd.—Satisfaction in full on February 17th, 1937, of debenture dated March 3rd, 1936, and registered March 19th, 1936, securing £40,000.

Electro-Dynamic Construction, Co., Ltd.—The nominal capital has been increased by the addition of £10,000 beyond the registered capital of £15,000. The additional capital is divided into 10,000 2nd preference shares of £1.

Premier Electric Services, Ltd.—The nominal capital has been increased by the addition of £1,100 beyond the registered capital of £1,400. The additional capital is divided into 700 "A" ordinary shares of £1 and 8,000 "B" ordinary shares of 1s. each.

Electrical Measuring Instruments Co., Ltd.—Debenture charged on the company's undertaking and property, present and future, including uncalled capital, dated February 15th, 1937, to secure £800. Holder: C. R. H. Stewart, 29, Mowbray Road, N.W.6.

Neon (Portsmouth), Ltd.—Debenture charged on the company's undertaking and property, present and future, includ-

ing uncalled capital, dated March 10th, 1937, to secure £1,500. Holders: Branch Nominees, Ltd.

Lamp Manufacturing & Railway Supplies, Ltd.—Capital, £9,000 in 5,500 preference and 3,500 ordinary shares of £1. Return dated December 7th, 1936. 4,500 preference and 3,003 ordinary shares taken up. £4,503 paid. £3,000 considered as paid. Mortgages and charges, nil.

Grierson, Ltd.—Capital, £10,000 in 4,000 preference and 6,000 ordinary shares of £1. Return dated December 7th, 1936. 4,001 ordinary shares taken up. £4,001 paid. Mortgages and charges, nil.

Hellesens, Ltd.—Capital, £160,000 in 112,000 "A" and 48,000 "B" shares of £1. Return dated December 11th, 1936. All shares taken up. £160,000 paid. Mortgages and charges, nil.

G. L. Adamson, Ltd.—Capital, £7,500 in £1 shares. Return dated March 31st, 1936 (filed February 13th, 1937). 5,605 shares taken up. £1,105 paid. £4,500 considered as paid. Mortgages and charges, nil.

B. French, Ltd.—Capital, £5,000 in £1 shares. Return dated December 14th, 1936. 4,750 shares taken up. £4,750 paid. Mortgages and charges, nil.

Alder Electrical Appliances, Ltd.—The nominal capital has been increased by the addition of £750 in £1 ordinary shares, beyond the registered capital of £750.

Electrical & Radio Products (1931), Ltd.—I. Levy, of 39, Cheapside, E.C.2, ceased to act as receiver and/or manager on March 8th, 1937.

H. O. Electrical Manufacturing Co., Ltd.—J. A. Youels, of 70a, Basinghall Street, E.C.2, ceased to act as receiver and manager on March 9th, 1937.

Cramill Electric Co., Ltd.—Mortgage on moneys due or becoming due in respect of certain contracts, dated March 5th, 1937, to secure all moneys due or to become due from the company to Martins Bank, Ltd., not exceeding £131.

Small Power Dynamo & Motor Co., Ltd.—Debenture, charged on the company's property, present and future, including uncalled capital, dated March 3rd, 1937, to secure £400. Holder: A. Bostock, 1336, Ashton Old Road, Higher Openshaw.

Baxter & Caunter, Ltd.—Capital, £10,000 in 4,000 ordinary and 6,000 cumulative 5 per cent. preference shares of £1. Return dated December 29th, 1936. 3,002 ordinary and 4,000 preference shares taken up. £7,002 paid. Mortgages and charges nil.

Electrical & General Development Co., Ltd.—Capital, £20,000 in 2,000 shares of £10. Return dated November 16th, 1936. 600 shares taken up. £6,000 paid. Mortgages and charges nil.

Corwen Electric Light Co., Ltd.—Capital, £2,000 in £1 shares. Return dated November 17th, 1936. 1,610 shares taken up. £1,610 paid. Mortgages and charges nil.

Eco Power, Ltd.—Capital, £1,000 in £1 shares. Return dated September 10th, 1936. All shares taken up. £1,000 paid. Mortgages and charges nil.

Curtis Manufacturing Co., Ltd.—Capital, £6,000 in £1 shares. Return dated September 23rd, 1936. All shares taken up. £1,000 paid, £5,000 considered as paid. Mortgages and charges nil.

Associated Utilities, Ltd.—Particulars filed of £100,000 debenture stock, authorised February 2nd, 1937, charged on assets of the company including the funds of the company invested in the stocks, shares or undertakings of public utility companies, the whole amount being now issued.

General Accessories Co., Ltd.—Particulars filed of £7,000 debentures, authorised March 12th, 1937, charged on the company's undertaking and property, present and future, including uncalled capital, the whole amount being now issued.

S. Sassoon & Co., Ltd.—The nominal capital has been increased by the addition of £2.000 in £1 ordinary shares beyond the registered capital of £1,000.

Venner Time Switches, Ltd.—The nominal capital has been increased by the addition of £48,000 in £1 ordinary shares beyond the registered capital of £90,000. The whole of the ordinary shares have been converted into stock.

City Notes

The North-Eastern Electric Supply Co., Ltd., held its annual meeting in Newcastle on March 24th when Mr. R. P. Sloan (chairman) said that, so far as new connections to the system were concerned, these exceeded the previous year's record and amounted to 122,075 h.p. This figure included a supply of electricity to one of the largest colliery companies in their area, which had closed down its own power station. This colliery represented a load of 48,600 h.p. They had operated the power station for the power company, and although they had lost the income obtained from this service they now reaped the benefit of the sale of electricity to the colliery company. With regard to their domestic business the number of new consumers connected last year was 19,990, while the number of new consumers of all classes was 21,377, making the total supplied directly from their system 220,874. This figure excluded 90,000 consumers supplied by other electricity supply authorities who redistributed energy taken in bulk from their company. During the past two years the reductions in their charges to domestic and small power consumers had exceeded £110,000 per annum, and they had recently announced a further substantial concession to domestic users which would come into force as from the commencement of the June quarter. The recommendations of the Special Committee appointed by the Government to consider the question of co-ordinating electricity distribution throughout the country conformed closely to the views held by the directors as to what should be done to improve the present state of affairs throughout the country. Good progress had been made in the sales of electricity to practically all the industries they owned. Improvement in the shipbuilding and engineering trades had been most marked and the coal mines appeared to be in a much more flourishing condition than was the case a short time ago. One by one, the remaining collieries in their area which utilised steam for power purposes were converting their plant to electric drive, and in practically all these cases power was being taken from the mains of the company. While they could look to the future with considerable confidence the shareholders were reminded that some of the improvement in trade in their area was due to the Government's defence programme and business accruing from their service must be looked upon as transitory. On the other hand, they were deriving the benefit of the improvement in industries not affected by this programme and the growth of their domestic supply business was still most encouraging. There was no doubt that the use of electricity was becoming more and more important to meet the daily necessities of the community at large, the effect of which was that the consumption of electricity per head of the population was an ever-increasing figure.

The British Thomson-Houston Co., Ltd., held its annual meeting on March 23rd, when Mr. W. C. Lusk (chairman) said that their manufacturing plants had been well maintained during the year, and in addition improvements had been made in their equipment which would still further increase its productive efficiency. Capital expenditure on manufacturing equipment and buildings, including extensions to the "Mazda" lamp factories, amounted to £248,209. They had received their share of the increased business available during the year, and both the volume of orders received and the shipments from their factories exceeded those for the previous year, and the unexecuted orders on hand at the end of the year were substantially greater than at the end of 1935. The number of employés reached a record high level at the end of the year, and had increased further since that date. Many important orders were received both at home and abroad for central station and sub-station plant, for heavy industrial applications for steel works and mines, and for the extensive range of other electrical apparatus that they produced, including apparatus for railway electrification and for the extension of the electric service and the trolley-bus service of the London Passenger Transport Board, and also for the new Empire broadcasting station at Daventry. The increased demand for "Mazda" lamps and "Mercra" electric-discharge lamps had necessitated the extension of the lamp factory at Rugby, and this extension was now in production. The demand had also increased for the various electrical appliances which they manufactured for their subsidiary selling company, the Hotpoint Electric Appliance Co. Some difficulty had been experienced in securing orders abroad in competition with the manufacturers of some other countries who benefited from a depreciated exchange or from assistance from their Governments, and this handicap would be more seriously felt when the volume of home orders became smaller. Their research organisation at Rugby had been further enlarged.

The Shropshire, Worcestershire and Staffordshire Electric Power Co.—Presiding at the annual meeting held on Wednesday last Sir Thomas Royden (chairman) said that the company had experienced another successful year, with a record in the number of kWh sold of over 234 millions. The cost of coal, however, was a matter of serious concern. They could no longer buy in a free market and present contracts for coal supplies showed increases of from 2s. to 4s. per ton over 1935 prices. The boiler extensions at the Stourport generating station were completed and in operation. The Central Electricity Board had directed them to increase the capacity of this station by a further 60,000 kW. to be available in September, 1938. Between Stourport and the Oldbury-Smethwick district the transmission system was being improved and the completion of present proposals would not only ensure adequate supplies to this area, but permit the closing down of certain old generating plant. During the period from 1931 to 1936 the capital expended on land buildings plant, mains, &c., increased by 33 per cent., or £2,000,000; consumers connected rose from 46,500 to 87,500 or 88 per cent., while the sales of electricity grew from 116 million kWh to 234 million kWh. The gross receipts from these sales increased by £480,000, or 78 per cent. Substantial tariff variations during 1936 placed their prices on a basis comparable with those ruling in a similar area of supply. With regard to the recommendations of the McGowan Committee, which were to be the subject of legislation in Parliament, the extensive network in their area and its organisation and administration put them in a position to accept any responsibilities or obligations which might be imposed upon them as a result of such legislation. The subsidiary companies were making good progress, particularly in the case of the South Wales Electric Power Co., whose selected station at Upper Boat was to be extended by direction of the Central Board, for operation in September, 1939.

The British Power and Light Corporation, Ltd., held its annual meeting on March 31st, when Capt. C. E. Benson (chairman), who presided, said that developments had taken place during the year in connection with the subsidiaries, the North Wales Power Co. and the Distribution Co. of North Wales. A blizzard which occurred on February 27th affected the whole of their area; ice loading on the conductors exceeded 4 in. in diameter. and as a result five steel transmission towers collapsed; eighty poles were also completely uprooted. Although the supply to the Colwyn Bay and Llandudno area was provided by three different routes, all those circuits were put out of action by the storm. The first scheme of development in the Isle of Anglesey had been completed and good progress was being made with a further scheme in the construction of an extensive system of transmission lines to serve the central portion of the island and the north-eastern coastal towns. Their hydro-electric stations had supplied nearly 70 per cent. of their total requirements, the balance being obtained from the Central Electricity Board. They had increased their storage reserve by nearly six million kWh. A new 6,500-kW generator had been installed at Dolgarrog, but the full benefit of this set would not be felt until the pipe-line extension was completed. There had been a growth in the sales of electricity and an increase in the number of consumers. In all, the extensions of their transmission and dis-

tribution system represented a total of 49 miles of h.v. lines, 41 miles of l.v. distributing mains, and 69 new sub-stations. They hoped to reduce the flat rate tariffs to domestic consumers in the North Wales area this year. They had made substantial reductions in the tariffs to the consumers supplied by their English companies. All their English companies were now going ahead and they anticipated that this progress would continue. The expert technical and commercial assistance which the subsidiaries were receiving from central management was beneficial to their consumers. An active and progressive sales policy was pursued, fostered by modern publicity and the offer of various facilities such as hire and hire-purchase terms for apparatus and wiring. Twenty-one showrooms had already been opened and two additional ones were under construction.

The Mersey Power Co., Ltd., held its annual meeting on March 23rd, when Mr. H. J. Falk (chairman), who presided, in the course of his speech referred to the wide area covered by the company and the many industries taking supplies from its system; current in bulk was also supplied to the area of the Mid-Cheshire Co. Cables laid rose by forty-four miles during 1936 to a total of 510 miles. Supplies to rural areas increased, and extensions were made in Widnes and Ellesmere Port for industrial purposes. Sixteen sub-stations were added during the year, bringing the total to 158. The Percival Lane station was operated under the Central Electricity Board, which took 52,000,000 kWh during 1936; in 1937 it was intended to allocate 60,000,000 kWh. Sales reached 80,000,000 kWh, an increase of 12,000,000 kWh or 17.5 per cent. over 1935, of which 30,000,000 kWh was drawn from the grid. Domestic consumption showed excellent results; the two-part tariff had proved a great success, while there was a continued demand for electric cookers, vacuum cleaners, etc., which was helped considerably by the hire-purchase system. Cable connections now averaged 76.7 per cent. of the premises over the whole area and in some regions were 90 per cent., and the increasing rise in consumption justified the provisions. In Lancashire and Cheshire their company sold the largest number of kWh per head of population. In 1926 their consumers were 3,008, in 1936 they reached 22,657. Mr. Falk referred to the higher price of coal, and said that electricity was inevitably more expensive because of this. When their station was "selected" a large expansion of plant was indicated, and now they were preparing plans and estimates for this purpose to be approved by the Electricity Commissioners. A request for the payment of an interim dividend on the ordinary shares would be considered, but the uncertainty as to further legislation and the effect of the McGowan Report made it imperative to exercise caution.

Associated Electrical Industries, Ltd., reports a profit for the year ended December 31st of £1,055,624, as compared with £828,519 in the preceding year. From this are deducted depreciation, £149,574, and income tax, £267,574. There is a net profit of £638.476 (£535,858), to which is added £165,405 brought in, making £803.881. A sum of £100,000 is placed to general reserve and £75,000 to writing off patents and goodwill, leaving a balance of £628.881. The ordinary dividend for the year is raised from 8 to 10 per cent., and £176,118 is carried forward. The report states that orders received during 1936, as well as orders in hand at December 31st, show a substantial increase over those for 1935. The outstanding preference and ordinary shares of the Edison Swan Electric Co., Ltd., were acquired during the year by an exchange of shares. In order to effect this exchange 23,378 ordinary shares of £1 each were issued, and the share capital of the company was increased by the creation of an additional 100,000 8 per cent. cumulative preference shares of £1 each, of which 74,592 shares have been issued.

The Anglo-Portuguese Telephone Co., Ltd., reports a net profit for 1936 of 89,087, as compared with £84,634 for 1935, which with £25,698 brought in, makes £114,785. The final dividend on the ordinary stock is 5 per cent., making 8 per cent. for the year (same) and 8 per cent. is again paid on the "A" ordinary shares. A sum of £20,561 is placed to reserve for renewals, and £26.285 is carried forward. In November last 185,625 ordinary shares of £1 were taken up by members at 23s. per share. Tariff negotiations resulted in agreement between the General Administration of Posts and Telegraphs and the company, and on June 23rd a decree was published authorising a new contract with the Government. This permits the message-rate method of charging for service to become universal throughout the system on July 1st next. It is proposed to increase the capital of the company to £1,700,000 by the creation of 350,000 additional ordinary £1 shares, and to convert the new shares into stock as issued. Meeting: April 7th.

British Insulated Cables, Ltd., reports a profit on trading (after contingent reserves adjustment), dividends on investments, interest, transfer fees, &c., of £765,695 for 1936, as compared with £672,591 in the preceding year. To this is added £303,860 brought in and after deducting debenture interest, &c., there is a balance of £874.561 available. Depreciation on buildings, plant, machinery, &c., absorbs £143,682 and reserve receives £100,000. The final ordinary dividend is 10 per cent., making 15 per cent .for the year, and in addition a cash bonus of 5 per cent. (both subject to tax) is paid (same), leaving £380,879 to be carried forward. It is proposed to create and issue 333,334 new ordinary shares fully paid, to be converted into stock and to be distributed by way of bonus at the rate of £1 ordinary stock for every existing £5 ordinary stock now issued, the new stock ranking for dividend as from January 1st, 1937. Meeting: April 22nd.

The Richmond (Surrey) Electric Light and Power Co., Ltd.—Presiding at the annual meeting held on March 23rd Sir Robert Renwick (chairman), said that the sales of electricity during 1936 totalled 11,199,535 kWh, an increase of 21.5 per cent. over the previous year. In an area such as Richmond supplies for domestic purposes predominated; these increased by 30 per cent. last year over the supplies for the same purposes in 1935. Consumers taking supplies under the two-part tariffs consumed on an average last year 1,800 kWh per head. Owing to the rapid growth of their load in the borough it had been found necessary to lay down a new transmission line to enable them to obtain greater supplies from the grid at Kingston. They had offered to supply the Corporation with free electricity for the floodlighting of public buildings and the decoration of streets during the Coronation celebrations.

The Automatic Telephone & Electric Co., Ltd., reports a profit of £133,564 for 1936, as compared with £120,283 in the preceding year, which, with £80,320 brought in, makes £213,884. General reserve receives £10,000. The final dividend on the ordinary stock is 7 per cent., making 10 per cent. for the year (against 9 per cent.), and a dividend of 10 per cent. is paid for the year on the deferred stock and shares (against 9 per cent.), leaving £85,446 to be carried forward. During the year under review the company took over the undertaking, assets and liabilities of its wholly owned subsidiary, Automatic Electric Co., Ltd. The figures in the balance-sheet reflect the results of that operation, and are not, therefore, in all cases specifically comparable with the corresponding figures for the previous year. Meeting: April 5th.

The Isle of Thanet Electric Supply Co., Ltd., reports a profit for 1936 of £72,156, as compared with £81,886 in the preceding year, to which is added interest received, £233, and £3,236 brought in, making £75,625. From this are deducted the following:—£14,540 to Margate, Broadstairs and district lighting area suspense account; £8,177 to sinking fund for redemption of capital expenditure on electricity supply; £15,000 to debenture stock service fund; £2,000 to tax reserve; £10,000 to writing off part of the loss on the transport undertaking; and £1,752 to expenses of issue of debenture stock and share capital. The balance available is £24,155, and the dividend on the ordinary shares for the year is maintained at 4 per cent., less tax, leaving £1,235 to be carried forward.

A. Reyrolle & Co., Ltd., have declared a final dividend on the ordinary shares of 7½ per cent., making 12½ per cent. for 1936 (same). It is proposed to increase the authorised capital to £1,000,000 by the creation of 300,000 £1 shares, and to issue 195,000 ordinary shares to ordinary shareholders in the proportion of one new share for every three shares held. The issue price will be 25s. per share.

Switchgear & Cowans, Ltd., is offering 80,000 ordinary shares of 5s. to ordinary shareholders at 16s. per share in the proportion of one new share for every five held. The new shares will rank for all dividends declared in respect of the financial year commencing January 1st, 1937, and will otherwise rank *pari passu* in all respects with the existing ordinary shares.

The Trafalgar Engineering Co.—The *Financial Times* reports that, in view of the small response to the offer for sale by the Sterling Securities & Investments Co. of 750,000 2s. ordinary shares at 3s. 6d. each in the Trafalgar Engineering Co., the directors of that company have decided not to proceed to allotment.

The Lancashire Electric Light & Power Co. has decided to offer the holders of the 7 per cent. participating preference and ordinary stock, 600,000 ordinary shares of £1 each at 27s. 6d. per share in the proportion of one new share for every five units of £1 of stock (preference or ordinary) held. It is proposed that the shares, when fully paid, shall be converted into stock.

Heenan & Froude have announced an interim ordinary dividend of 4 per cent.

Stocks and Shares

Tuesday Evening.

STOCK Exchange markets are seldom distinguished by conditions of activity after the Easter holiday, and the present year has shown no deviation from the common course of events. The public appetite for new issues gives unmistakeable signs of slackening. The rush to buy armament, engineering and aviation shares has noticeably subsided. Gilt-edged stocks and shares remain steady at their previous levels. The opening of the Budget on April 20th is expected to synchronise with an official announcement regarding the offer of a hundred million pounds of the new Defence Loan. The Easter weather should have assisted to provide bumper traffics on the transport services. Investment business waits upon the development of a variety of factors connected with foreign politics.

When Money Matters

The second quarter of the year entered, on Thursday last week, to find the money market situation rather complicated. Money itself is abundant, in spite of the heavy calls made upon it by the new French and other loans. Nevertheless, estimates are being put forward to explain why an advance in Bank rate—2 per cent. since June, 1932—may possibly be anticipated. Such guesses meet with no great attention. They are perhaps related to the calling-in of loans in certain directions at the end of this March. American speculators in American shares have discovered that it is cheaper and easier to finance purchases in London than in New York, where heavy restrictions are laid upon speculative transactions. The facilities offered for this class of business have been recently curtailed in London. The immediate effect is not without its reaction upon international stocks and shares of different classes.

Central Electricity Stocks

Publication of the results of the Central Electricity Board's second full year of working could scarcely have failed to create a good market impression. Although still entitled to charge the whole of its interest charges to capital account, the Board is this year paying out of revenue the interest on five of the

seven issued stocks, actually, earnings were enough to cover interest on all seven. In arriving at this position two years ahead of schedule, the Board gives a convincing answer to the somewhat sceptical attitude adopted by a good many people at the time of its formation with regard to its ability to meet all obligations out of revenue. From the investment point of view the stocks are generally now regarded as being amongst the best of their kind. The market is prepared to see, from now on, a steady consolidation of the financial position, rather than a continuance of spectacular progress.

Central Electricity stocks have not escaped the depreciation which has, during recent months, afflicted the whole fixed-interest range. Present prices are a long way below last year's best levels. The difference is 8 points or more in the cases, for instance, of the 4½ per cents 1951-73 and the fives of 1950-70. During the same period the price of War Loan has fallen by about 6 points.

Electricity Supply Issues

The market for home electricity supply shares is emerging from the depression of recent weeks. Midland Electric Power have risen to 42s. 6d., which is $\frac{3}{16}$ higher than the quotation that ruled before declaration of the higher dividend and the publication of the accounts. Northampton and North Metropolitans each rose by $\frac{1}{16}$ to 48s. 9d. and 51s. 3d. respectively. Gains of up to 1s. were secured by, amongst others, Edmundsons, now 42s., British Power and Light, 27s. 9d., Metropolitans 49s., and Scottish Power 39s. The brighter atmosphere apparently owes little to conditions outside the market. Of the two brakes which have most effectively been holding confidence in check, the trend of gilt-edged stocks continues to give negligible encouragement, while the situation created by Government intentions towards the industry has, of course, undergone no change. Signs of a restoration of confidence in the shares can be attributed to recognition of their intrinsic investment value, which has been emphasised in no uncertain manner by this year's crop of reports and meetings. Business started at the end of last week in the newly issued Midland Counties Electric 4¼ per cent. preference shares. These are being dealt in at a premium of a few pence over the issue price of 20s. 6d. Lancashire Electric dropped 1s., to 35s., on publication of the terms of the proposed capital increase.

Manufacturing and Equipment Shares

The downward price tendency which for a month or two has been making itself felt in industrial markets appears to have spent a good deal of its force. In spite of generally quiet conditions there are signs that the appearance of any fresh stimulus, such as a brightening of the atmosphere either on the Continent or in America, might well induce a turnround for the better. Electrical equipment shares can be relied upon to benefit, amongst the first, from a revival of interest in home industrials. Changes in this week's list are few and unimportant. Bargain-hunters were attracted to Aron Meters, which recovered from 2⅜ to 2¾ on the belief that the fall had been overdone. General Electrics at 87s. have lost a little ground in sympathy with Associated Electrical. Switchgear and Cowans, at 17s. 3d., are quoted ex-rights to the new shares. The latter, issued at 16s., are changing hands at around 1s. 3d. premium. The price of Lancashire Dynamo shares at 75s. is still inclusive of rights to the offer of new shares on a one-in-three basis at 61s. per share. British Aluminium spurted a further 2s. 6d. to 54s., the increase in the dividend from 7½ per cent. to 10 per cent. being very favourably received.

Dividend Announcements

Although coming closely into line with previous expectation, announcement of the Associated Electrical Industries dividend and results was followed by a small decline in the price of the shares. On the new dividend rate of 10 per cent. the present price of 51s. for the shares offers the buyer a return of a little under 4 per cent. on his money. Automatic Telephone and Electric shares gave little response to the 1 per cent. increase in the ordinary and deferred dividends. The price of the ordinary rose a few pence to 47s. 6d. but fell away later to 46s. 6d., at which level the yield on the 10 per cent. dividend works out at £4 6s. per cent. The higher distribution, as also the 10 per cent. on the deferred shares, are to the advantage, of course, of the British Insulated Cables Company, which not long ago acquired from American interests the whole of the "A" deferred capital in the Automatic Telephone.

London-Toronto

This, Tuesday afternoon, the Chairman of the London Stock Exchange, seated in the Committee Room by the side of the High Commissioner for Canada, touched a switch that caused a gong to sound in the new Stock Exchange building thus formally opened in Toronto. The gong gave the signal for business to start in the Toronto exchange. Within a few yards of the chairman in London, officials of the Western Union Telegraph Company were busily and audibly exchanging messages of good will and greetings between the two Stock Exchanges. It was a pleasant function, characteristic of the manner in which the limits imposed by time and space are being broken down under the march of science, ingenuity and invention.

Share List of Electrical Companies

	Nom.	Dividend. Previous.	Dividend. Last.	Price. Mar. 30.	Rise or Fall.	Yield. p.c. £ s. d.
Home Electricity Companies.						
Bournemouth and Poole	1	15	15	71/3	—	4 4 0
City of London	1	7½	7½	35/6	—	4 4 6
Clyde Valley	1	7	8	42/6	—	3 15 5
County of London	1	10½	10½	50/6	+6d.	4 3 8
Edmundson's 7% Pref.	1	7	7	33/	—	4 10 0
Do. Ord.	1	8	8	42/-	+1/-	3 16 1
Elec. Dis. Yorkshire	1	9	9	43/6	+1/-	4 2 9
Elec. Fin. and Securities	1	12½	12½	2⅞	—	4 7 0
Elec. Supply Corporation	1	11	11	54/6	—	4 0 9
Lancs Light and Power	1	7½	7½	35/-	−1/-	4 5 9
Lond. Assoc. Electric	1	—	7	32/6	—	4 6 2
London Electric	1	7	8	35/6	—	4 10 3
London Power Deb. Red.	Stock	5	5	106½	—	4 14 0
Metropolitan	1	10	10	49/-	+1/-	4 1 8
Midland Counties	1	7½	8	38/6	+6d.	4 3 3
Mid. Elec. Power	1	8	9	2½	+ 1/16	4 5 0
North Eastern Electric Ordinary	1	6	7	34/-	—	4 2 4
Do. 7% Pref.	1	7	7	34/-	—	4 2 4
Northampton	1	10	10	48/9	+ 1/16	4 2 0
Notting Hill 6% Pref.	10	6	6	14	—	4 5 9
North Met. Elec. Ordinary	1	10	10	2 1/16	+ 1/16	3 18 0
Do. do. 6% Pref.	1	6	6	29/6	—	4 1 4
Scottish Power	1	8	8	39/-	+1/-	4 2 1
South London	1	7	7	32/-	−1/-	÷ 7 6
Whitehall Elec. Invst. 7½% Pref.	1	7½	7½	23/6	—	6 7 8
Yorkshire Elec.	1	8	8	42/6	+6d.	3 15 2
Public Boards.						
Central Electricity, 1950–70	Stock	5	5	112	—	4 9 3
Do. 1955–75	„	5	5	113	—	4 8 6
Do. 1951–73	„	4½	4½	106½	—	4 4 6
Do. 1963–93	„	—	3½	97½	—	3 11 10
London Elec. Trans. Gtd.	„	—	2½	89½	—	2 15 10
London & Home Counties, 1955–75	„	4½	4½	110	—	4 1 10
London Passenger Transport, A.	„	—	4½	112½	—	4 0 0
Do. do. B.	„	—	5	110½	—	4 3 8
Do. do. C.	„	4½	4	90	—	4 9 0
West Midlands Joint Elec. 1948–68	„	—	5	112½	—	4 9 0
Telegraph and Telephone						
American Tel. & Tel.	$160	9	9	175½	+2	5 2 9
Anglo-Am. Tel. Pref.	Stock	6	6	122	—	4 18 4
Do. Def.	„	1½	1½	28½	—	5 7 2
Cable & Wireless 5½% Pref.	„	4½	5½	112	+1	4 18 1
Do. A. 7½% Ord.	„	Nil	Nil	29½	—	—
Do. B. Ord.	„	Nil	Nil	9	−½	—
Globe Tel. & Tel. Ord.	10	3½*	4½*	15¾	+½	2 17 2
Do. do. Pref.	10	6	6	13½	+½	4 9 0
Great Northern Tel.	10	20	20	42	—	4 15 3
Marconi-Marine	1	10	7½	1⅝	—	4 5 9
Oriental Telephone Ord.	1	12*	12*	3 5/16	—	3 15 6
Home and Foreign Trams, etc.						
Anglo-Arg. Trams First Pref.	5	Nil	Nil	4/6	—	—
Do. do. 2nd Pref.	5	Nil	Nil	3/9	—	—
Do. do. 5% Deb.	Stock	Nil	Nil	20½	—	—
British Electric Traction Df. Ord.	„	5	5	1475	—	—
Do. do. Pref. Ord.	„	8	8	165	—	4 15 5
Brazil Traction	$100	—	70 cts.	27⅝	+1⅛	—
Brit. Columbia Elec. Rly. Pce.	Stock	5	5	104½	—	4 14 9
Mexican Light Common	$100	Nil	Nil	4½	—	—
Do. 1st Bonds	$500	5	5	42½	—	—
Victoria Falls Ord.	1	20	12	72/-	−6d.	3 6 8
West Riding	1	6½	10	46/3	—	4 6 7
Manufacturing Companies.						
Aron Electricity Ord.	1	10	15	2⅝	+⅛	5 4 4
Assoc. Elec. Ord.	1	8	10	51/-	−1/-	3 18 6
Do. Pref.	1	8	8	37/-	—	4 6 6
Babcock & Wilcox	1	8	8	49/6	−6d.	3 4 8
British Aluminium Ord.	1	7½	10	54/-	+2/6	3 14 1
British Insulated Ord.	Stock	20	20	6½	—	3 5 0
Brush Ord.	Stock	Nil	Nil	52½	—	—
Callender's	1	15	15	4 5/16	—	3 5 9
Do. 6½% Pref.	1	6½	6½	28/9	—	4 10 5
Crompton Parkinson Ord.	5/-	12½	12½	70/-	—	—
Do. 8% Pref.	1	8	8	37/6	—	4 5 4
Electric Construction	1	3½	7	40/-	—	3 10 0
Enfield Cable Ord.	1	25	25	5 7/16	—	4 12 0
English Electric	1	Nil	Nil	34/-	—	—
Do. do. Pref.	1	6½	6½	24/-	—	5 8 4
Ericsson Tel.	5/-	20	25	52/6	—	2 7 7
Ever Ready	5/-	35	35	31/6	—	5 11 1
Ferranti Pref.	1	7	7	26/3	—	5 6 8
G.E.C. Pref.	1	6½	6½	31/3	—	4 3 2
Do. Ord.	1	10	15	87/-	−1/-	3 9 0
Henleys	5/-	30	30	20/3	—	3 14 1
Do. 4½% Pref.	1	4½	4½	1½	—	4 0 0
India-Rubber Pref.	1	5½	5½	22/6	—	4 17 9
Johnson & Phillips	1	7½	10	48/3	—	4 3 0
Lancashire Dynamo	1	10	20	3⅞	—	5 6 6
Siemens Ord.	1	5	6	35/-	—	3 8 7
Telegraph Construction	£1	Nil	7½	2½	—	3 6 8

* Dividends are paid free of Income Tax.

Published Specifications

Compiled expressly for this journal by a firm of chartered patent agents. The numbers in parentheses are those under which all specifications will be printed and abridged and all subsequent proceedings will be taken.

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15956. "Electromagnetic coils for loudspeakers and telephone receivers." R. Stolojian. November 26th, 1934. (462224.)
17994. "Systems comprising piezo-electric crystals." A. Guerbilsky. June 22nd, 1935. (Convention date not granted.) (462109.)
18099. "Television." E. L. C. White. June 24th, 1935. (462110.)
18920. "Joints for electric cable systems." Callender's Cable & Construction Co., Ltd. (Okonite-Callender Cable Co., Inc.) July 2nd, 1935. (462287.)
21445. "Hydrometers particularly applicable to fitting in electric accumulators." J. H. Collie. July 29th, 1935. (Cognate application 5111/36.) (462051.)
21523. "Electric signal transmission systems." Electric & Musical Industries, Ltd., and W. S. Percival. July 29th, 1935. (Addition to 446663.) (462228.)
23981. "Control systems for electric traction motors." General Electric Co., Ltd., and E. P. Collett. August 27th, 1935. (462235.)
24156. "Electrical rectifier installations." S. A. Stevens and Westinghouse Brake & Signal Co., Ltd. August 29th, 1935. (462172.)
24207. "Heating elements for electrically heated apparatus." G. H. Collins and H. F. Collins. August 30th, 1935. (462173.)
24210. "Electric insulators." Taylor Tunnicliff & Co., Ltd., and E. D. Spencer. August 30th, 1935. (462174.)
24309. "Electric-discharge lamps." British Thomson-Houston Co., Ltd. August 30th, 1934. (462356.)
24444. "Cathode-ray tubes." H. P. Barasch. September 2nd, 1935. (462243.)
24510. "Dynamo-electric machines." Klaxon, Ltd., and E. T. Cook. September 2nd, 1935. (462302.)
24554. "Automatic or semi-automatic telephone or like exchange systems." Standard Telephones & Cables, Ltd., E. P. G. Wright, G. C. Hartley and P. I. Wyndham. September 3rd, 1935. (462180.)
24594. "Tubular electric heating devices." A. Karcher. March 2nd, 1935. (462305.)
24656. "Valve-amplifying circuits for television and like purposes." A. J. Brown and Baird Television, Ltd. September 4th, 1935. (462247.)
24573. "Permanent magnets." Siemens & Halske Akt.-Ges. September 10th, 1934. (462248.)
24587. "Magnetron tubes and circuit arrangements incorporating same." Telefunken Ges. für Drahtlose Telegraphie. September 4th, 1934. (462252.)
24697. "Electric induction motors." J. W. Swendsen. September 4th, 1935. (462253.)
24797. "Electric fluid blast circuit-breakers." British Thomson-Houston Co., Ltd. September 7th, 1943. (462137.)
24821. "Shades or reflectors for electric lamps or other light sources." Troughton & Young, Ltd., and A. B. Read. September 5th, 1935. (462312.)
24845. "Television and like systems." G. W. Walton. September 6th, 1935. (Addition to 432017.) (462258.)
24848. "Mounting of street-lighting and like lamps." Revo Electric Co., Ltd., and F. H. Reeves. September 6th, 1935. (462139.)
24853. "Automatic electric cut-out devices." C.A.V.-Bosch, Ltd., and W. H. Glaser. September 6th, 1935. (Cognate application 865/36.) (462314.)
24872. "Electrically operated gas-lighters." C. G. Lange. September 6th, 1935. (462317.)
24914. "Radio receivers." Marconi's Wireless Telegraph Co., Ltd. September 29th, 1934. (462323.)
24969. "Radio and like modulated carrier wave tunable receivers." Marconi's Wireless Telegraph Co., Ltd., and R. F. O'Neill. September 7th, 1935. (462328.)
24970. "Thermionic oscillation generators." Marconi's Wireless Telegraph Co., Ltd., and D. A. Bell. September 7th, 1935. (462329.)
24972. "Television picture reproducing apparatus." Marconi's Wireless Telegraph Co., Ltd., and R. J. Kemp. September 7th, 1935. (462330.)
25160. "Electric-discharge devices." British Thomson-Houston Co., Ltd. September 11th, 1934. (462363.)
25984. "Apparatus for directional illumination." General Electric Co., Ltd., and S. S. Beggs. September 19th, 1935. (Addition to 360664.) (462056.)

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742. "Wireless aerial insulator." C. Hardman. February 8th, 1936. (462074.)
7541. "Straining clamp for overhead electric conductors." C. G. Neck. May 10th, 1935. (462081.)
7898. "Electric heating elements." C. B. Backer. May 21st, 1935. (462263.)
10249. "Controllers for electric circuits." Igranic Electric Co., Ltd. May 2nd, 1935. (462264.)
10757. "Lamps for the interior lighting of motor-cars." P. Krageloh and H. Krageloh (trading as T. Krageloh & Co.). December 18th, 1935. (462085.)
11288. "Electric clock mechanisms." R. Dewaele. April 20th, 1935. (462087.)
11325. "Arc-convertors." Allgemeine Elektricitats-Ges. April 18th, 1935. (462088.)
15626. "Television." W. C. Bailey. June 4th, 1936. (462216.)
17454. "Systems for remote control of apparatus over power or like mains." Siemens-Schuckertwerke Akt.-Ges. September 20th, 1935. (462270.)
18398. "Prepayment telephone apparatus." L. V. Bossche and V. Verheyden. July 2nd, 1936. (462217.)
21096. "Hand apparatus for light-ray treatment, especially for medicinal purposes and for the activation of substances by means of ultra-violet rays." H. Weiland. July 30th, 1936. (462103.)
21121. "Röntgen-ray apparatus." Siemens-Reiniger-Werke Akt.-Ges. August 26th, 1935. (462152.)
21511. "Stroboscopic device for checking and adjusting electric meters." Union d'Electricité. August 10th, 1935. (Cognate application 21512/36.) (462104.)
22744. "Braun tubes." M. Von Ardenne. August 28th, 1935. (462275.)
24107. "Electric storage batteries." Pritchett & Gold & E.P.S. Co., Ltd., and K. Preston. September 3rd, 1936. (462157.)
25447. "Automatic switching systems for interconnection of tele-typewriters." Standard Telephones & Cables, Ltd. October 5th, 1935. (462159.)
26314. "Electric heating elements." C. B. Backer. May 21st, 1935. (Divided out of 462263.) (462280.)
29590. "Television receiving apparatus." General Electric Co., Ltd., N. R. Campbell, and L. C. Jesty. December 31st, 1935. (Divided out of 36084/35.) (462281.)
34913. "Heating elements for electrically heated apparatus." G. H. Collins & H. F. Collins. August 30th, 1935. (Divided out of 462173.) (462221.)

Trade Mark Applications

The following are among the recent applications for British trade marks. Objections against any of the proposed marks may be entered within one month from March 24th:—

Cuprotectic. No. 574293. Class 5. Metallic alloys containing copper.—The British Oxygen Co., Ltd., Thames House, Millbank, Westminster, S.W.1.

Ferrotectic. No. 574294. Class 5. Metallic alloys containing iron.—The British Oxygen Co., Ltd., address as above.

G.C.M. Electric Cables (lettering and design). No. 572889. Class 8. Electric cables.—The General Cable Manufacturing Co., Ltd., Genita Works, Kingston Road, Leatherhead, Surrey.

Armourlight. No. 572094. Class 15. Electric insulators, containers for batteries, &c.—Pilkington Bros., Ltd., Martins Bank Building, Water Street, Liverpool.

Metalect. No. 574552. Class 18. Electric furnaces (not for scientific purposes).—Metalectric Furnaces, Ltd., Metalectric Works, Cornwall Road, Smethwick, Birmingham.

Rubtex. No. 572556. Class 40. Electric insulation materials composed principally of india-rubber, &c.—Arthur Parker, 77, Troy Court, W.8.

New Norwegian Cable

Overhead cable which will resist corrosion, support its own weight without the aid of a carrier wire and nevertheless is comparatively light is a Norwegian invention by Mr. Wessel, of Drammen. The conductors and the interior construction of the Wessel cable are of conventional design, but the ordinary lead coating has been replaced by acid-proof welded steel. This serves the double purpose of protecting the interior wires and carrying the whole weight of the cable lengths between the poles, to which it can be fixed direct. Best quality "Sandvika OR 2" steel is used for the coating of the Wessel cable, which weighs only ¼ ton per km. The outer diameter of a 10-pair telephone cable is about 9 mm., and a breaking strength of 1,800 kg. is guaranteed. These data indicate that the weight of a Wessel cable is only about half that of an ordinary cable with carrier wire, while the breaking strength is twice as great. A trial length of the new cable has been in use at Tonsberg since November, 1935.

Sixteen ordinary overhead telephone wires replaced by one Wessel cable

Street Lighting

The importance of good road lighting in the avoidance of traffic accidents was emphasised in a recent address on "The Real Aim of Street Lighting" by Dr. S. English before the Dublin centre of the Illuminating Engineering Society. He said that local authorities did not always realise that the modern increased use of roads at night required far better lighting than sufficed thirty years ago. Illuminating engineers had kept pace with the need for very much improved street lighting, and during the last few years the technical advances made had been little short of revolutionary, but it did appear to be necessary to bring some specialists "down to earth" and to get them to realise that there was something in the points of view held by other people regarding the means by which good street lighting might be achieved. In some towns sheet lighting appeared to be the Cinderella of public services.

New Work for Contractors

Particulars of new works and building schemes for the use of electrical installation contractors and traders

Publication in this list is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors.

Alloa.—Houses (84), Tullibody Road; R. Cairns, burgh surveyor, Municipal Buildings.

Altrincham (Cheshire).—Hospital (£120,000), for the General Hospital Board of Management; secretary.

Alvechurch (Worcestershire).—Factory, for Hall & Mound, Tame Road, Birmingham.

Ashbourne (Derbyshire).—Houses (58), Clifton Road site; D. Powell, U.D.C. surveyor.

Ayr.—Reconstruction of Ritz Cinema, for the Newton-on-Ayr Picture House Co., Ltd., Glasgow.

Birkenhead.—Houses (96); B. Robinson, borough surveyor.

Birmingham.—Factory, Hack Street, Digbeth; C. H. Plant, builders, Ansell Road, Erdington.

Blackburn.—Aerodrome; borough engineer.

Border (Cumberland).—Houses (40), Longtown; R.D.C. surveyor.

Bridlington.—Hotel, Barmston; Wheatley and Houldsworth, architects, Savile House, Savile Street, Hull.

Bristol.—Community centre, Knowle estate (£16,988); A. S. Wilkins, Son & Coventry.

Bury.—Reconstruction of the Theatre Royal, for the directors of the Northern Theatres Co., Ltd., Ainsworth Street, Blackburn; C. R. Cooper, architect, 8, St. Mary's Place.

Buxton.—Extensions to the Institution for the Board of Management of the Devonshire Royal Hospital (£35,000); Sir P. F. Worthington, Thomas Worthington & Sons, architects, 178, Oxford Road, Manchester.

Castleford.—Extensions to factory for Town Tailors, Ltd.

Chapel-en-le-Firth.—Factory, for Ferodo, Ltd.; Butterworth & Duncan, architects, 2, Baillie Street, Rochdale.

Chester.—Houses (19), Sandy Lane; R. W. Walker. Varnish factory; C. H. Coppack. School, Newton, for E.C.

Connah's Quay (Chester).—Houses (81); U.D.C. surveyor.

Coventry.—Houses (168), Barras Heath estate; A. F. Underhill, housing director. Cinema, Fletchamstead; G. Cave, architect.

Croydon.—Branch libraries, Mitcham Road and Hartland Way, Shirley; borough engineer, Town Hall.

Dolgelley (Merionethshire).—Houses (30), Ardd Fawr; U.D.C. surveyor.

Dorking (Surrey).—Cinema, London Road, for the Gaumont-British Picture Corporation, Ltd.; H. Weston, architect, 81, Chester Square, London, S.W.1.

Dudley.—Houses (114), Saltwells Road, Netherton; F. H. Gibbons, borough engineer, Council House.

Durham.—School, Swalwell, for County E.C.; county architect, 34, Old Elvet, Durham.

Ealing.—Factory for W. Kidde & Co., Ltd., Belvue Road.

Edinburgh.—Houses (352), Oxgengs Road; MacTaggart and Mickel, Ltd., Bath Street, Glasgow.

Frome.—Rebuilding premises, Mells, for the Coleford Co-operative Society.

Gateshead-on-Tyne.—Factory, Team Valley Trading estate, for A. G. Nicholls; Marshall and Tweedy, architects, 129, Pilgrim Street, Newcastle-on-Tyne. Factory, Team Valley Trading estate, for the Wilden Furnishing Co., Ltd.; J. W. Hanson and Sons, architects, 18, Eldon Square, Newcastle-on-Tyne. Extensions to works for the British Ropes, Ltd.; J. Milne and Sons, builders, Coatsworth Road.

Glasgow.—Factory, Bridgeton Cross, for J. Tullis & Son, Ltd., Tullis Street; J. T. Thomson, architect, 212, Bath Street, Blythswood.

Greenford.—Granada Cinema, Greenford Road, for the Bernstein Theatres, Ltd.; Dixon & Braddock, architects, 33, Bedford Place, W.C.1.

Grimsby.—School, Macaulay Lane (£34,295) for E.C.

Hillington.—Development of Oak Farm estate; H. B. Silver.

Ilford.—Houses (25), Herent Drive; Lord and Mellodew, Ltd. Flats (40) at the junction of Cranbrook Road and Gantshill Crescent; Marshall & Tweedy, builders. Shops and dwellings, Suffolk Parade, Eastern Aveiue; J. H. Lowden. Houses (75), Hanover Gardens; Davis Estates, Ltd., 346, Kilburn High Road, N.W.6.

Keighley.—Houses (160); borough engineer.

Kettering.—Extensions to Avondale school; J. T. Blackwell, architect, Gold Street Chambers.

Kidderminster.—Houses, Wolverley; Pritchard Godwin and Clist, Bank Buildings. Shops and offices, 15, Vicar Street; Price's Tailors, Ltd.

Kirkham (Lancashire).—Houses (34), Barnfield (£12,000); Pius Baines & Son, Ltd., builders, Preston.

Lincolnshire.—School, near Briar Way and Richmond Drive, Skegness, for C.C. (Lindsey division); P. W. Birkett, county architect, County Offices, Newlands, Lincoln.

Liverpool.—Branch bank and house, Hillfoot Road, for the Westminster Bank, Ltd., Lothbury, London, E.C.2. A. E. Shennan, architect, North House, 17, North John Street.

Llanrwst (Denbighshire).—Houses (26), Cae Person Field; U.D.C. surveyor, Plasyndre.

London.—(Battersea).—Extensions to premises of Mark Mayhew, Ltd.; Gelder & Kitchen, architects, Hull. (Camden Town).—Buildings, Kentish Town Road; Aerated Bread Co., Ltd. (Chelsea).—Buildings, Denver Street, Leverett Street and Mossop Street; Slater & Moberly, 46, Berners Street, W.1. Shops and flats, King's Road; Marshall & Tweedy, 9, Cavendish Street, W.1. (Finchley).—Health centre, Oak Lane; borough engineer. Nine shops and flats, High Road; Varley Estates, Ltd. (Fulham).—Dwellings, Bagleys Lane (£68,207); Unit Construction Co., Ltd. Factory, Peterborough Road; Hurlingham Bungalow Co., Ltd., Peterborough Road, S.W.6. Tenements, Palace Road (£53,000); Gee, Walker & Slater, Ltd., Fitzmaurice Place, W.1. (Putney).—Premises, for the British Home Stores, Ltd.; A. L. Farman, architect, 42, Richmond Park Road, S.W.14. (Stoke Newington).—Cinema, Stamford Hill; A. Mather, Leicester Chambers, Leicester Square, W.C.2.

Macclesfield.—Houses, Ivy Road estate and the Grey House estate, for the trustees of Clarke & Brookes; P. Wright, architect, King Edward Street.

Maidstone.—Houses (24), Hubbard's Lane, Loose; R.D.C. surveyor.

Manchester.—Dental school and hospital, Oxford Road, for the senate of the Manchester University; Thomas Worthington & Sons, architects, 178, Oxford Road.

Middlesbrough.—Houses, Acklam Road; E. T. Sweeting, builder, Back Haymore Street. Houses, Highfield Road, Lansdowne Road and Park Road South; T. Crawford, architect, 82, Borough Road. Houses, Park Road South, for the owners of the Middlesbrough Estate, Ltd., Queen's Square; F. Jackson, staff architect. Houses, Ulla Farm estate; T. Duncanson and Sons, builders, Beechwood, Acklam. Houses (770), with a shopping centre; C. Gorman, borough engineer. Alterations and additions to premises, for E. Upton and Sons, Linthorpe Road; Archibald and Archibald, architects, 26, Albert Road.

Morecambe.—Houses (40), Anstable Road; Russell Bros.

Morpeth.—Houses (184), Stobhill; F. Perkins, borough engineer.

Mottingham (Kent).—Hotel (£25,000); W. G. Ingram, architect, 4, Zerulam Buildings, London, W.C.1.

Newcastle-on-Tyne.—Houses (24) in flats, Fairholm Road, for I. Gold and Son; F. M. Dryden, architect, 6, Market Street. Business premises, Buckingham Street, for the Newcastle Co-operative Society; Co-operative Wholesale Society architects' dept., 90, Westmorland Road. Conversion of Louis Café, Northumberland Street, into a news cinema, for the Hinge's Cinemas, Ltd.; T. Clements and Son, builders, Selbourne Gardens. Alterations, Grainger Street, for J. Moses and Co., Ltd.; Marshall and Tweedy, architects, 129, Pilgrim Street. Extensive alterations, Saville Row, for G. T. Harvey; P. J. Stienlet and Son, architects, 5, Saville Chambers.

Newport (Shropshire).—Houses (20), Broomfield Road; Jenkins and Byrom, architects, Central Chambers, Wellington.

Newport Pagnell.—Hotel for P. Phipps & Co., Northampton.

North Shields.—Shops, Billy Mill Avenue, for J. H. Grant, Manor House, Promenade, Whitley Bay.

Northumberland.—School, Forest Hall, for C.C.; county architect, County Hall, Newcastle-on-Tyne.

Nottingham.—Laundry, Meadow Lane, for the Co-operative Midland Laundry Association; Co-operative Wholesale Society building dept., Manchester.

Pewsey (Wiltshire).—Houses (68); R.D.C surveyor.

Rhyl.—Additions to the nurses' home, Prince Edward Memorial Hospital; F. A. Roberts, architect, Mold.

Rugby.—Extensions to St. Cross Hospital (£11,000).

St. Ives (Cornwall).—Houses (225); borough surveyor.

Salford.—Extensions to Museum and Art Gallery, Peel Park (£20,000); W. A. Walker, city engineer.

Sheffield.—Extensions to works, Colver Road, for A. Spafford & Co., Ltd., Imperial works; A. Appleby & Sons, architects, St. James Street. School, Shirecliffe, for E.C.; education architect.

Shipley.—School, Red Beck, for E.C. Extensions to works, Wrose Brow Road; Lee & Crabtree.

South Shields.—Junior instruction centre, near Boys' High school, for E.C.; borough engineer.

Southall (Middlesex).—Flats (112), Balfour Road; New Ideal Homesteads, Ltd., Ideal House, Carlton Road, Erith.

Stafford.—School, Dartmouth Street; director of education, Education Offices.

Stirling.—Church reconstruction (£40,000); J. Miller, architect.

Sutton Coldfield.—Houses (38), near Orphanage Road; B. P. Housing, Ltd.

Swale (Kent).—Houses; L. A. Randerson, architect, 48, Bell Road, Sittingbourne.

Todmorden.—Baths (£11,797), Centre Vale; P. P. Taylor (Doncaster), Ltd.

Tottenham.—Improvements to Woodlands school, for E.C.

Tredegar (Monmouthshire).—Houses (30), Old Tramroad site (£22,840); U.D.C. surveyor.

Ventnor (I.O.W.).—Houses (40), Lowtherville; James Ball & Sons, builders.

Wallasey.—Gymnasium, Coronation Avenue, for E.C.

Warsop.—Houses (50), Sandy Lane estate; B. C. Westwick, U.D.C. surveyor.

Warwickshire.—School, Lode Lane, for Solihull County E.C.; county architect, Shire Hall, Warwick.

Wigton.—Houses (78); S. Mann, architect, 28, Lowther Street, Carlisle.

Mercury-arc Rectifiers

Some of the most practical information on various applications of electricity is to be found in the publications of manufacturers. To operators of a.c.-d.c. converting plant a booklet of thirty-two pages entitled "The Mercury Arc Rectifier" (*The Electric Construction Co., Ltd.*, 2s. 6d.) can be recommended. This gives a simple explanation with the aid of a dozen adequate circuit diagrams of the functions and elementary principles of a piece of static apparatus that should be "as reliable as a transformer" without going into the theory of the subject, for which reference should be made to ordinary text-books. Of the numerous photographic illustrations, the series of five showing how bulbs should be handled and placed in position ought to be particularly useful.